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ıtic Vascular Plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae

by

C. B. Hellquist and G. E. Crow

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ABSTRACT

This paper is the first in a series of reports on the aquatic and wetland flora of New England. It treats all species of the Zosteraceae, Potamogetonaceae, Zannichelliaceae and Najadaceae occurring in New England and includes keys, comments on taxonomy and nomenclature, habitat and distributional information, water chemistry data, illustrations and dot maps. Several species are regarded as rare and endangered in one or more of the six New England states and are so noted.

One taxon, Potamogeton filiformis var. occidentalis (previously reported as P. vaginatus) is newly reported for New England.

KEY WORDS: Aquatic Plants, New England Flora, Taxonomy, Potamogetonaceae, Zosteraceae, Zannichelliaceae, Najadaceae, Potamogeton, Ruppia, Zostera, Zannichellia, Najas, Pondweed, Eelgrass, Widgeon-grass, Horned Pondweed, Naiad.

Table of Contents

INTRODUCTION 1

FAMILY KEY 2

ZOSTERACEAE 3

Zostera 3

Zostera marina 3

Selected References 3

POTAMOGETONACEAE 3

Potamogeton 5

Key to Species 5

Potamogeton robbinsii 12

Potamogeton pectinatus 12

Potamogeton filiformis 12

Potamogeton bicupulatus 17

Potamogeton spirillus 17

Potamogeton diversifolius 17

Potamogeton epihydrus 21

Potamogeton confervoides 21

Potamogeton zosteriformis 21

Potamogeton hillii 26

Potamogeton foliosus 26

Potamogeton friesii 26

Potamogeton strictifolius 26

Potamogeton obtusifolius 31

Potamogeton pusillus 31

Potamogeton vaseyi 36

Potamogeton lateralis 36

Potamogeton natans 36
Potamogeton oakesianus 40
Potamogeton crispus 40
Potamogeton amplifolius 40
Potamogeton pulcher 40
Potamogeton nodosus 40
Potamogeton alpinus 46
Potamogeton gramineus 46
Potamogeton illinoensis 46
Potamogeton praelongus 52
Potamoteton richardsonii 52
Potamogeton perfoliatus 52
Selected References 56
Ruppia 57
Ruppia maritima 57
Selected References 59
ZANNICHELLIACEAE 59
Zannichellia 59
Zannichellia palustris 59
NAJADACEAE 61
Najas 61
Key to Species 61
Najas guadalupensis 61
Najas flexilis 61
Najas gracillima 64
Najas minor 64
Selected References 64
LITERATURE CITED 67

AQUATIC VASCULAR PLANTS OF NEW ENGLAND: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae

by

C. B. Hellquist and G. E. Crow

INTRODUCTION

This is the first in a series of reports on the aquatic and wetland flora of New England. Eventually all of the reports will be combined into a manual of aquatic and wetland plants of New England. By releasing these preliminary reports on families or groups of families we hope for constant updating through field work until the final manual is prepared.

A treatment of the aquatic and wetland plants of the New England region has long been needed. The manual is being prepared to aid conservationists, fish and game personnel, consultants, botanists and students in the identification of aquatic plants. The coverage is strictly New England but is of value throughout the northeast. Data have been gathered from herbaria in New England and from personal field work.

Chemical data presented have been gathered from many waters throughout New England. The alkalinity readings are total alkalinity, expressed as milligrams per liter (mg/l) $CaCO_3$. Since pH and alkalinity vary greatly during the day, the values are only indicative of the water quality. Chloride values are given where data are available and of value.

The rare and endangered plant lists referred to are those prepared for each of the six New England States by the New England Botanical Club in cooperation with the United States Fish and Wildlife Service, Office of Endangered Species, Newton Corner, MA (Church and Champlin, 1978; Coddington and Field, 1978; Countryman, 1978; Eastman, 1978; Mehrhoff, 1978; Storks and Crow, 1978).

We invite comments and/or criticisms on this report. Information on any species omitted or any known localities not documented by us will be welcomed. If anyone is interested in specific localities of any of the species indicated on the dot maps, please contact us.

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FAMILY KEY

1. Leaves alternate

    2. Plants marine or of estuaries; leaves up to 2 m long, all submersed; flowers imperfect; inflorescence an elongate, flattened spike, surrounded by a sheathing leaf-like spathe at maturity (fig. 1A,B).
    ..... Zosteraceae

    2. Plants freshwater or estuarine; leaves much less than 2 m long, submersed and/or floating; flowers perfect (2 per spike in Ruppia); inflorescence a cylindric spike, enveloped by stipule (Potamogeton) or sheathing leaf base (Ruppia) during development, becoming exserted at maturity (fig. 9A, 37A).
    ..... Potamogetonaceae

1. Leaves opposite, occasionally appearing whorled

    3. Plants perennial, rhizomes common (fig. 38A); leaves entire, without broadened bases; flowers and fruits borne on short stalks; fruits bilaterally symmetrical, usually dentate (occasionally minutely spinulose) on one side (fig. 38B).
    ..... Zannichelliaceae

    3. Plants annual; rhizome lacking (fig. 39A); leaves mostly serrate, with broadened, sheathing bases (fig. 38B, C); flowers and fruits sessile; fruits radially symmetrical, smooth.
    ..... Najadaceae

ZOSTERACEAE

Zostera (Eelgrass)

Submersed plants of estuaries and sea water along the coast; arising from rhizomes; flowers unisexual, borne in rows on the upper side of a leaf-like spathe.

1. Zostera marina L. Fig. 1, Map 1

Common in estuaries, bays and along the open coast. The taxon in New England is treated as var. stenophylla Aschers. and Graebn. by Fernald (1950). Range extends from Greenland to Florida and along the west coast of the United States and Canada.

Selected References

Setchell, W. A. 1929. Morphological and phenological notes on Zostera marina L. Univ. Calif. Publ. Bot. 14: 389-452.

Setchell, W. A. 1933. A preliminary survey of the species of Zostera. Proc. Natl. Acad. U.S.A. 19: 810-817.

POTAMOGETONACEAE

1. Flowers several to many, exerted above stipule at anthesis, stamens 4; fruit sessile on a cylindric spike (fig. 3A), sometimes appearing capitate; floating leaves (fig. 9A) present or absent; stipules free from leaf blade (fig. 18B) or if fused with leaf blade, then the tip free (fig. 3B).
   ..... 1. Potamogeton

1. Flowers 2, enclosed in leaf sheath at anthesis, stamens 2; fruit long-stalked (fig. 37A); floating leaves absent, stipules fused with leaf blades, free tip lacking (fig. 37B).
   ..... 2. Ruppia

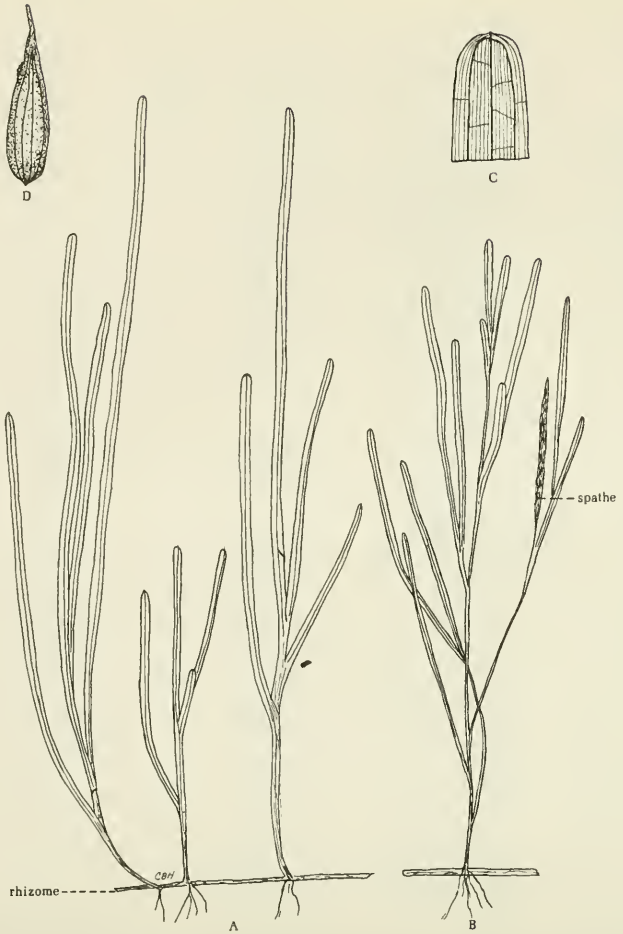
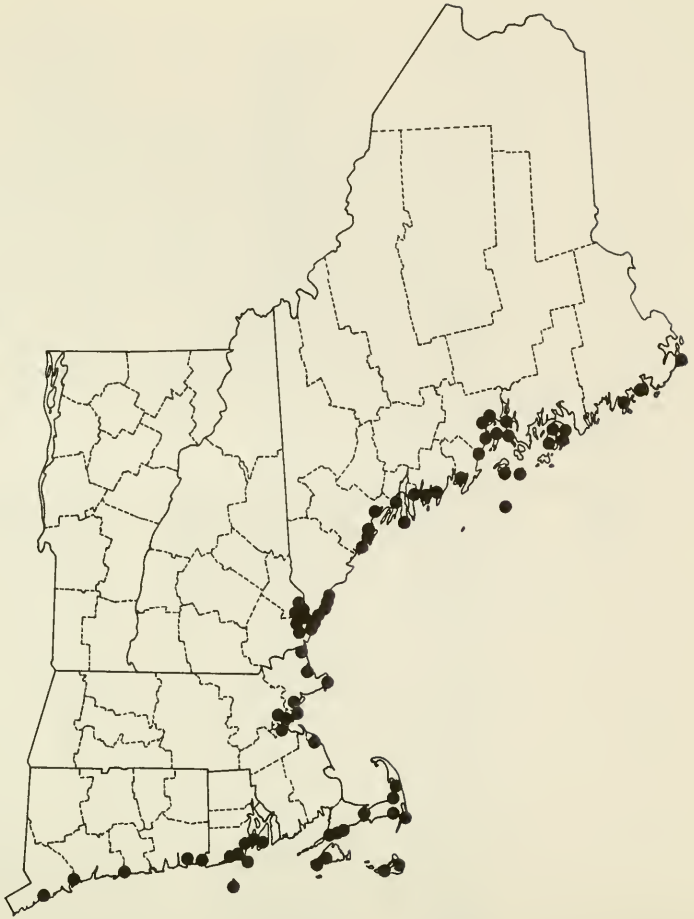


Figure 1.
Zostera marina: A-B. habit. C. leaf. D. fruit.



Map 1.
Zostera marina

Potamogeton (Pondweed)

Plants of fresh or saline water; growing from rhizomes or winter buds; leaves alternate, variable, with a characteristic mid-vein; floating leaves present in many species; flowers borne in spikes which may or may not rise above the water's surface; fruits drupaceous. Many hybrids occur, particularly between the broad-leaved species.

Key to Species

Plants with stipules adnate to leaf sheaths (figs. 2D, 3B, 6B).

2. Stipules adnate to leaf for 10 mm or more (figs. 2D, 3B); floating leaves absent; fruit usually without a lateral keel, embryo indistinctly coiled (figs. 3E, 5C).

    3. Leaves 3-8 mm wide, stiffish, 2-ranked, lobed at junction with stipule (fig. 2D); leaves usually with fine serrations, seen under magnification (fig. 2C).
    ..... 1. *P. robbinsii*

    3. Leaves 0.2-2.0 mm wide, lax, not distinctly 2-ranked, nor lobed at base; leaves without serrations.

        4. Leaves acute (fig. 3D), apiculate on young plants (fig. 3C); fruits beaked (fig. 3E).
        ..... 2. *P. pectinatus*

        4. Leaves blunt (fig. 5H), obtuse (fig. 4E), notched (figs. 4C,D, 5G) or rarely apiculate (fig. 4F).
            5. Plants tall, 3-10 dm long; stipules on lower portion of stem loose and inflated (fig. 4B), disintegrating early (fig. 4A); leaves 0.5-2.0 mm wide
            ..... 3. *P. filiformis* var. *occidentalis*

            5. Plants short, 1-3 dm long; stipules on the lower portion of the stem usually tightly clasping, not disintegrating (figs. 5D,E); leaves 0.2-0.8 mm wide
            ..... 4. *P. filiformis* var. *alpinus*

2. Stipules adnate to leaf for a distance of less than 10.0 mm; floating leaves absent or present; fruit with obvious lateral keel and embryo distinctly coiled (figs. 6C, 7C,D, 8D).

6. Submersed leaves 0.1-0.6 mm wide, tapering to a long point (fig. 6B), lacunae not abundant; middle stem leaves 190-500 times as long as broad; free portion of stipule 3 or more times as long as the fused portion; floating leaves (fig. 6A), 3-7-veined, the apicies acute.
..... 5. P. bicupulatus

6. Submersed leaves 0.5-2.0 mm wide, not long tapering; lacunae abundant (fig. 8C); middle stem leaves less than 190 times as long as broad; free portion of stipule not more than twice as long as fused portion; floating leaves 5-15-veined, the apicies acute or obtuse (figs. 7A, 8A).

7. Tips of submersed leaves obtuse (fig. 7E); fruit 1.3-2.2 mm wide, lateral keels scarcely developed (fig. 7D), or rarely well developed (fig. 7C), beak lacking.
..... 6. P. spirillus

7. Tips of submersed leaves acute (fig. 8B); fruit 1.0-1.5 mm wide, lateral keels well developed, minute beak present (fig. 8D).
..... 7. P. diversifolius

1. Plants with stipules completely free (figs. 14C, 15D, 18B).

8. Submersed leaves linear, with parallel margins, 0.1-10.0 mm wide (figs. 9A, 11C, 12A).

9. Lacunae prominent in submersed leaves (figs. 9D, 10B), 2-10 mm wide; floating leaves often present; fruit with keel 0.2-1.2 mm broad.
..... 8. P. epihydrus

9. Lacunae not prominent in submersed leaves, (except in some specimens of P. pusillus var. tenuissimus), 0.1-3.2 mm wide; fruit with keel less than 0.2 mm broad.

10. Floating leaves absent.

11. Rhizome long and creeping (fig. 11A); peduncle 15-24 cm long (fig. 11A); leaves thread-like (fig. 11A,C), 0.1-0.5 mm wide.
..... 9. P. confervoides

11. Rhizome short or lacking; peduncle 0.3-10 cm long, often curved (figs. 13A, 14A); leaves usually not thread-like (figs. 12-19) [except in P. pusillus var. gemmiparus (fig. 20)], 0.1-3.2 mm wide.

12. Nodal glands absent (fig. 14C).

13. Leaves 15-25-veined (fig. 12B),

greater than 2.0 mm wide; fruits 3-3.5 mm wide (fig. 12F).
..... 10. P. zosteriformis

13. Leaves 3-5-veined (fig. 13F, 15C), usually less than 2.0 mm wide; fruits less than 3.0 mm wide.

14. Leaves usually bristle-tipped (figs. 13B,F); occasionally apiculate (fig. 13D) to blunt (fig. 13E), 3-veined, 1-2.2 (-4) mm wide, peduncles slightly clavate, recurved, axillary or terminal, 0.6-1.35 cm long; fruits 3-keeled (fig. 13G), 3-4 mm long.
..... 11. P. hillii

14. Leaves acute (fig. 14D), 3 (-5)-veined, 0.3-1.5 (2.7) mm wide; peduncles clavate, usually recurved 0.3-1.1 (-3.7) cm long, axillary; fruits 1-keeled (fig. 14B), up to 2.7 mm long, usually 1.8-2.3 mm.
..... 12. P. foliosus

12. Nodal glands present (figs. 15D, 16G, 18B).

15. Stipules coarsely fibrous (figs. 15D, 16G), often whitish.

16. Leaf tips rounded or apiculate (fig. 15C); leaves 5-7 (-9)-veined (fig. 15C); winter buds with inner leaves at a right angle to outer leaves.
..... 13. P. friesii

16. Leaf tips usually bristled (fig. 16B); leaves acute (figs. 16C,D) or rarely obtuse to apiculate (fig. 16E), 3-5 (-7)-veined; winter buds flattened with inner and outer leaves in the same plane.
..... 14. P. strictifolius

15. Stipules not fibrous, usually delicate (fig. 18B), greenish, brown, or white.

17. Leaves 0.2-3.5 mm wide, apex blunt (fig. 18D) to acute (fig. 19F), 3-5-veined; peduncles

0.35-8.0 cm long.

18. Leaves 1.0-3.5 mm wide, often rufescent (reddish-brown); apex rounded (fig. 17C) or slightly apiculate; fruits with dorsal keel or ridge (fig. 17B).
..... 15. P. obtusifolius

18. Leaves 0.2-2.5 mm wide, usually green; apex obtuse (fig. 19B), apiculate (fig. 19D) or acute (fig. 19F), fruits with a rounded dorsal surface, (figs. 18F, 19I).

19. Leaves with up to 2 rows of lacunae along both sides of the midrib (fig. 19F), apex acute (fig. 18E), rarely apiculate; stipules mostly connate (united, surrounding stem) peduncles mostly terminal, 1.0-6.2 cm long, 1-3 per plant; inflorescence usually of 2-4 distinct, interrupted whorls (fig. 18A).
..... 16. P. pusillus var. pusillus

19. Leaves with up to 5 rows of lacunae on both sides of midrib, apex obtuse (fig. 19B) to acute (fig. 19F); stipules mostly convolute (rolled); peduncles axillary or terminal, 0.5-4.6 (-6.6) cm long, more than 3 per plant; inflorescence crowded (fig. 19A).
..... 17. P. pusillus var. tenuissimus

17. Leaves 0.2-0.7 mm wide, apex acute (fig. 20C), leaves 1-veined; peduncles 1.0-3.5 cm long.
..... 18. P. pusillus

10. Floating leaves present on at least some plants in population (Figs. 21A, 22E).

    20. Floating leaves 0.6-1.5 cm long, 5-9-veined; submersed leaves thin and transparent; fruit less than 2.5 cm long.

        21. Submersed leaves 0.1-1.0 mm wide; floating leaves 5-9-veined, often obovate (fig. 21A); winter buds common (fig. 21E); fruit compressed with distinct dorsal keel and recurved beak (fig. 21B); no fruit on plants with only submersed leaves.
        ..... 19. P. vaseyi

        21. Submersed leaves 0.4-1.0 mm wide; floating leaves 5-7-veined, usually spatulate (fig. 22E); winter buds usually absent; fruit slightly compressed with strongly rounded back (fig. 22D), (fruit very similar to P. pusillus); winter buds occasionally found; fruit only on plants with submersed leaves, but plants with floating leaves may bear flowers.
        ..... 20. P. lateralis

    20. Floating leaves, 1.5-12.0 cm long, 7-37-veined; submersed leaves thick and phyllodia-like (or stem-like) (fig. 23A); fruit 2.5-3.5 cm long.

        22. Submersed (phyllodial) leaves 0.8-2.0 mm wide; floating leaf blades 2.5-6.0 cm wide, 13-37 veins, usually heart-shaped at base (fig. 23A), (floating leaves in strong currents lack heart-shaped bases); petiole pale at summit; fruits mostly 3.5-5.0 mm long, keels obscure (fig. 23B).
        ..... 21. P. natans

        22. Submersed (phyllodial) leaves 0.3-1.0 mm wide; floating leaf blades 1.0-3.0 cm wide, rounded or wedge-shaped at base (fig. 24A); petiole not pale at summit; fruits mostly 2.5-3.5 mm long, keels prominent (fig. 24B).
        ..... 22. P. oakesianus

8. Submersed leaves non-linear, without parallel margins (figs. 26A, 30A), 10.0 mm-75.0 mm wide.

    23. Stem flattened; margins of leaves conspicuously toothed (fig. 25B); stipules slightly fused to base of leaf; fruit beak 2-3 mm long (fig. 25C); winter

buds common and extremely hard.
..... 23. P. crispus

23. Stem round in cross-section; leaves not toothed; fruit beak 1.0 mm long or less; winter buds rare, soft.

24. Submersed leaves sessile (but not clasping) (figs. 29A, 30A), or petioled (figs. 26A, 27A, 28A); floating leaves absent or present.

25. Submersed leaves 27-37-veined (fig. 26A), distinctly arced (fig. 26A).
..... 24. P. amplifolius

25. Submersed leaves less than 27-veined, not arced.

26. Stems conspicuously black-spotted; submersed leaves curly or wavy along the margin (fig. 27A); floating leaves 21-35-veined.
..... 25. P. pulcher

26. Stems not conspicuously black-spotted; submersed leaves not curly or wavy along the margin; floating leaves 2-29-veined.

27. Submersed leaves with petiole 2-13 cm in length (fig. 28A); fruit length 3.5-4.3 mm.
..... 26. P. nodosus

27. Submersed leaves sessile (figs. 29A, 30A, 31, 32, 33A) (occasional leaf petiolate to 4.0 cm long in P. illinoensis); fruit length less than 3.5 mm.

28. Submersed leaves 7-veined (often with up to six additional faint veins) with apex obtuse (figs. 29B,C) or acute (figs. 29D,E); reticulate portion along midrib, reddish color on drying; stipules blunt (fig. 29A); fruit plump, tawny-olive, pedicelled (figs. 29G,F).
..... 27. P. alpinus

28. Submersed leaves 3-17-veined (all prominent) with apex acute or with an awl-like tip (figs. 31, 33A), lacking obvious reticulate portion along the midrib, not reddish color on

drying; stipules acute; fruit laterally compressed, reddish-brown, not pedicelled.

29. Stem commonly branched (fig. 30A); submersed leaves always sessile, 1.5-4.5 (-13) cm long, blades (3-) 5-9 (-11)-veined.
..... 28. P. gramineus

29. Stem rarely or once branched; submersed leaves sessile (ocassional leaf petiolate up to 4.0 cm long), blades 5.0-20.0 cm long, (7-) 9-19-veined (fig. 33A).
..... 29. P. illinoensis

24. Submersed leaves clasping stem (figs. 33A, 34A, 35A); floating leaves absent.

30. Rhizomes spotted with rusty red; leaves ovate-oblong, (5-) 10-20 (-25) cm long (fig. 34A), apex boat-shaped (curved upward) (fig. 34C), and splitting when pressed (fig. 34D); stipules usually persistent and conspicuous.
..... 30. P. praelongus

30. Rhizomes unspotted; leaves roundish-ovate (fig. 36E), orbicular (Fig. 36G) to lanceolate (Fig. 36H), 1-10 cm long, apex flat; stipules inconspicuous (fig. 36A) or disintegrating into fibers (fig. 35A).

31. Leaves ovate-lanceolate (fig. 35C) to narrowly-lanceolate, 3-10 cm long, with 7-33 coarse veins; stipules coarse, disintegrating to persistent white fibers, even on the lower portion of the stem (fig. 35A).
..... 31. P. richardsonii

31. Leaves orbicular (fig. 36C) to ovate (fig. 36G), becoming lanceoclate in soft water (fig. 36H), 1.0-6.0 cm long, 0.5-2.0 cm wide, with 7-17 delicate veins; stipules disintegrating and absent on the lower portions of the stem.
..... 32. P. perfoliatus

1. Potamogeton robbinsii Oakes Fig. 2, Map 2

Abundant in deep water and slow streams. The type locality is Cherry Pond, Lancaster, New Hampshire. This species is especially distinctive among North American Potamogetons. It is not closely related to any other species and its pollen has a unique surface pattern. It is usually found at greater depths than most pondweeds, and then, sterile. Plants approaching the surface often flower, but seldom set fruit. Only three populations among those documented in New England herbaria were represented by material with mature fruit. Leaves normally have very minutely toothed margins (use strong lens). P. robbinsii forma cultellatus Fassett lacks toothed margins and is uncommon in New England. Range extends from Labrador west to British Columbia, south to New Jersey, Indiana, Alabama, Utah, and California; most abundant in the northeast.

alkalinity: mean, 26.1 mg/l; range 3.0-103.5 mg/l
pH: mean 7.2; range 6.3-8.9

2. Potamogeton pectinatus L. Fig. 3, Map 3

Locally abundant in scattered locations along the coast and inland in calcareous lakes, rivers and shallow streams of western New England, uncommon elsewhere. Although this species is the major pondweed for duck food (Metcalf, 1931), its food value in New England is low due to its limited occurrence. Range extends throughout the United States and Canada.

Rare and endangered plant list: New Hampshire

alkalinity: mean 91.7 mg/l; range 27.5-231.5 mg/l
pH: mean 8.0; range 6.5-10.7
chloride: mean 408.2 mg/l; range 3.3-4095.0 mg/l

3. Potamogeton filiformis Pers. var. occidentalis (Robbins) Morong Fig. 4, Map 4

Known only from two locations in northern Aroostook County, Maine. The nomenclature used follows Cronquist et al. (1977). This robust variety is characterized by inflated stipular sheaths in young plants which are similar to those of P. vaginatus Turcz. These sheaths deteriorate early, hence are lacking on older plants. This was previously reported as P. vaginatus by Hellquist (1977). Range extends from Nova Scotia west through southern Canada, south to Maine, Michigan, Texas, Colorado, New Mexico, and Arizona.

alkalinity: mean 103.5 mg/l
pH: mean 7.3

4. Potamogeton filiformis Pers. var. alpinus (Blytt) Aschers. and Graebner Fig. 5, Map 5

Locally abundant in shallow calcareous waters and marl springs of Aroostook County, Maine; uncommon at scattered locations in northern New Hampshire and Vermont. This taxon is

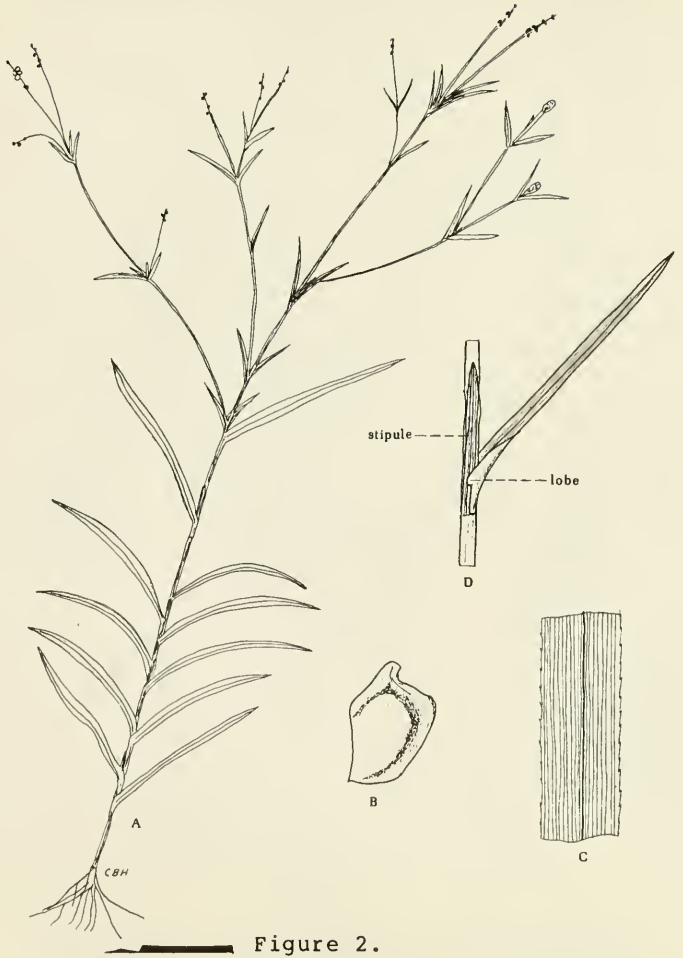
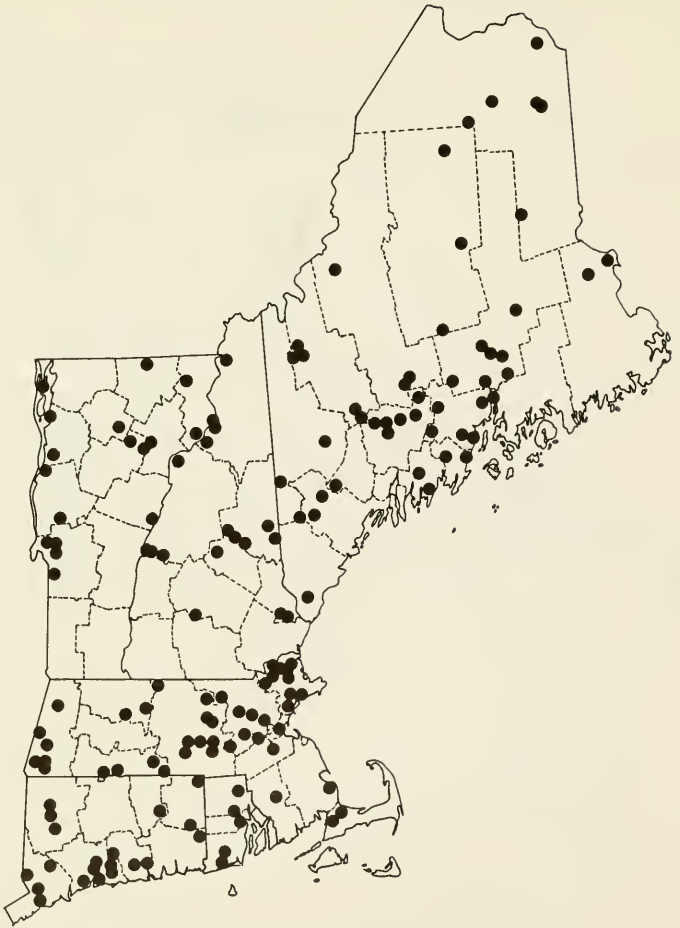


Figure 2.
Potamogeton robbinsii: A. habit. B. immature fruit. C. portion of leaf D. leaf base.



Map 2.
Potamogeton robbinsii

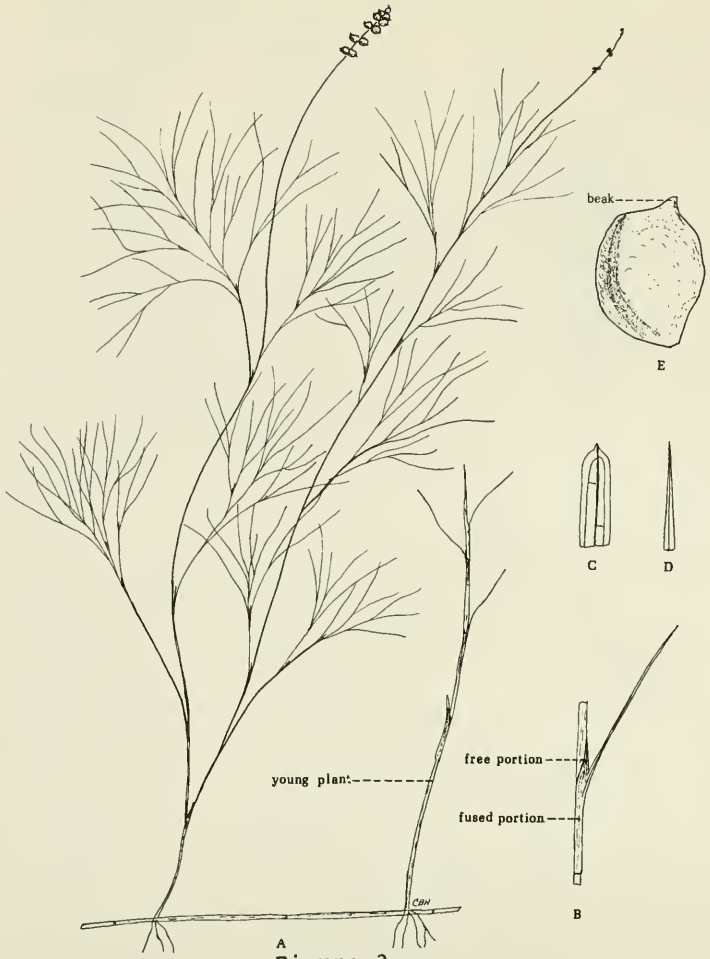
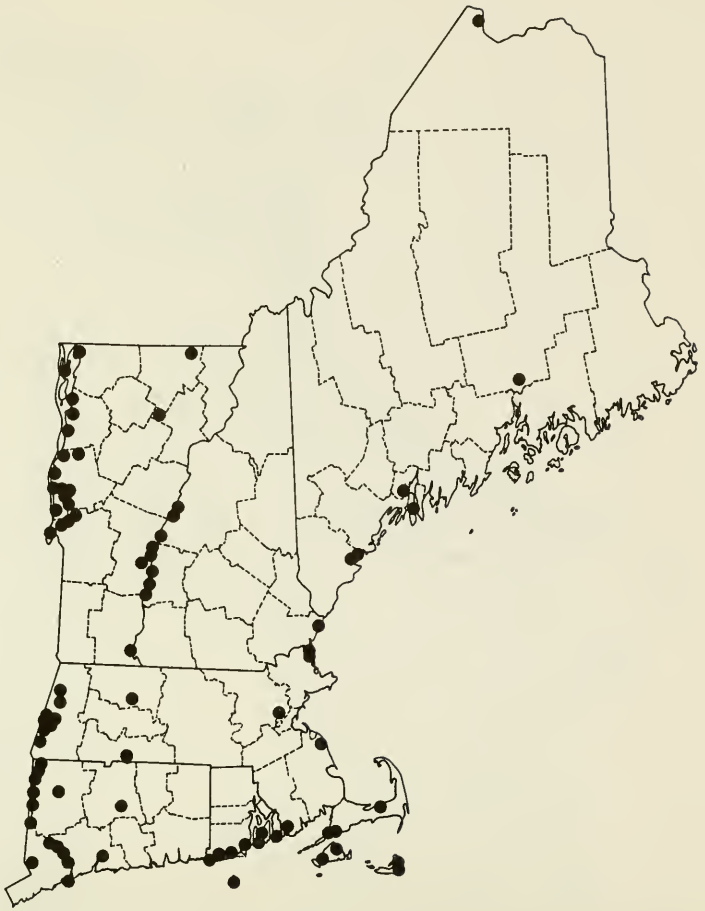


Figure 3.
Potamogeton pectinatus: A. habit. B. leaf base and adnate stipule. C-D. leaf tips. E. fruit.



Map 3.
Potamogeton pectinatus

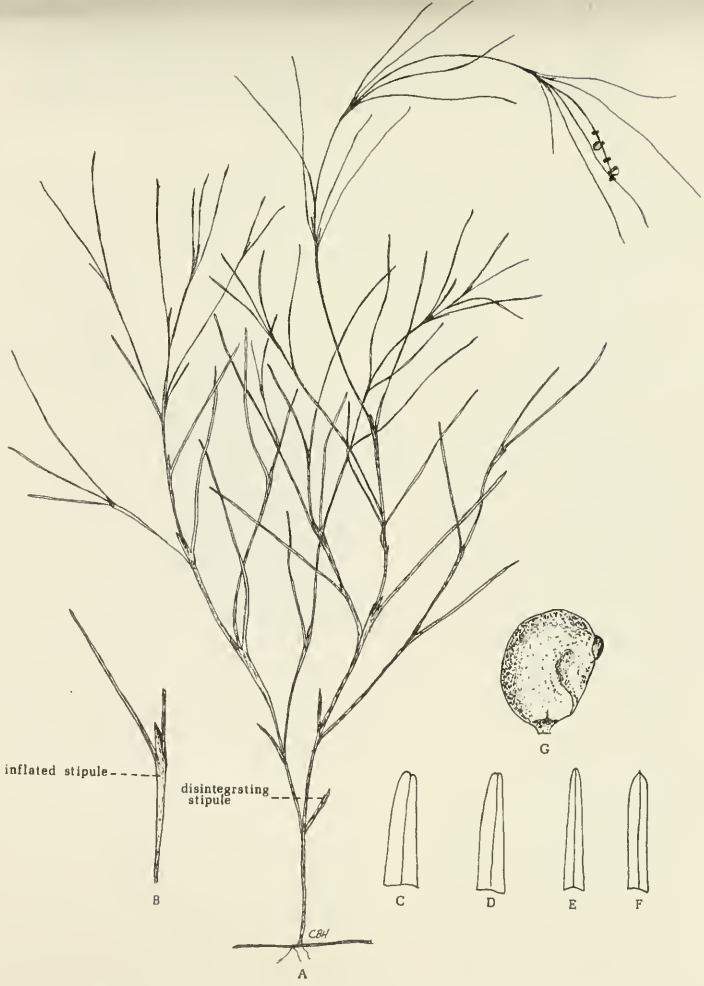
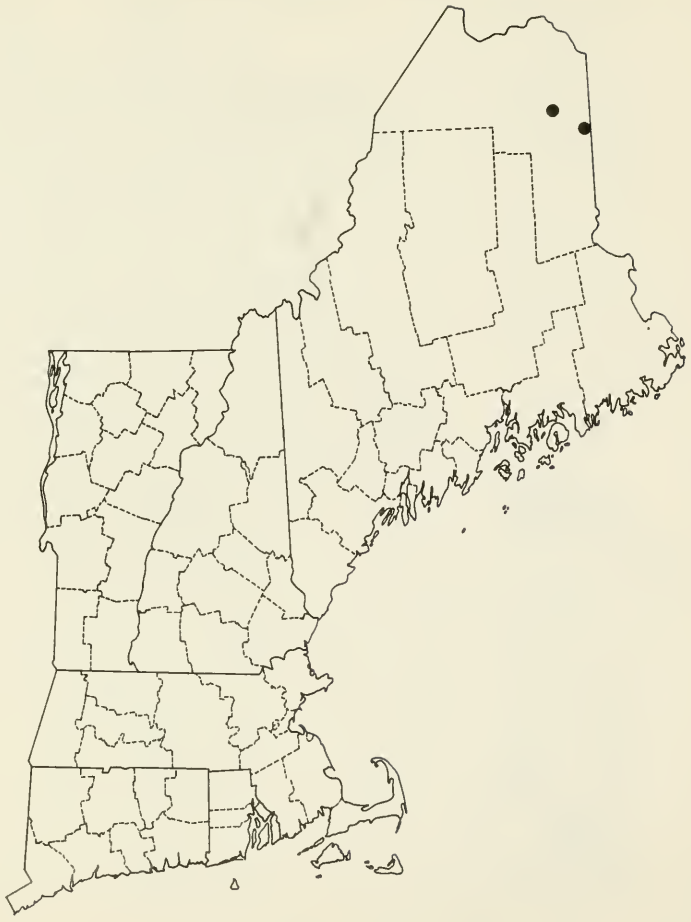


Figure 4.
Potamogeton filiformis var. occidentalis: A. habit. B. leaf base and adnate stipule. C-F. leaf tips. G. fruit.



Map 4.
Potamogeton filiformis
var. occidentalis

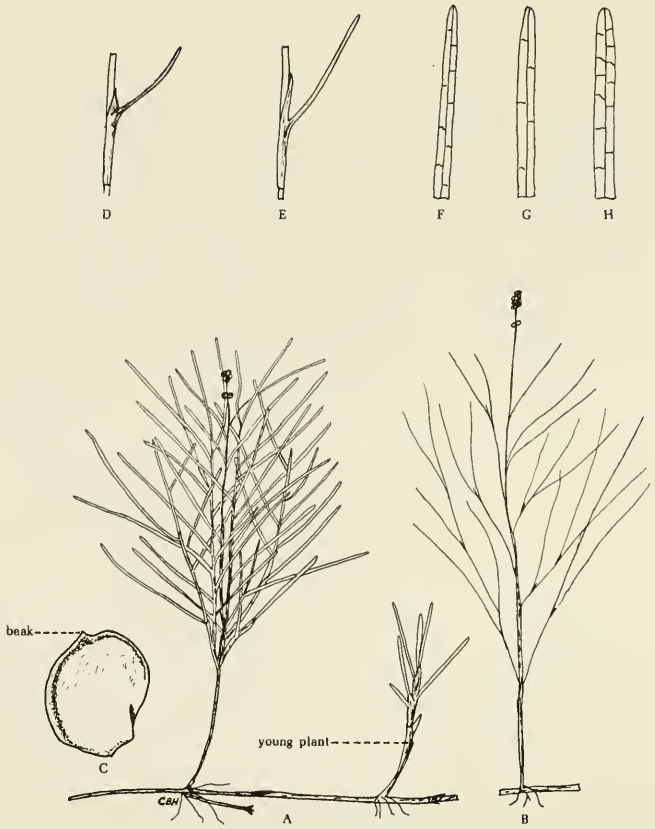
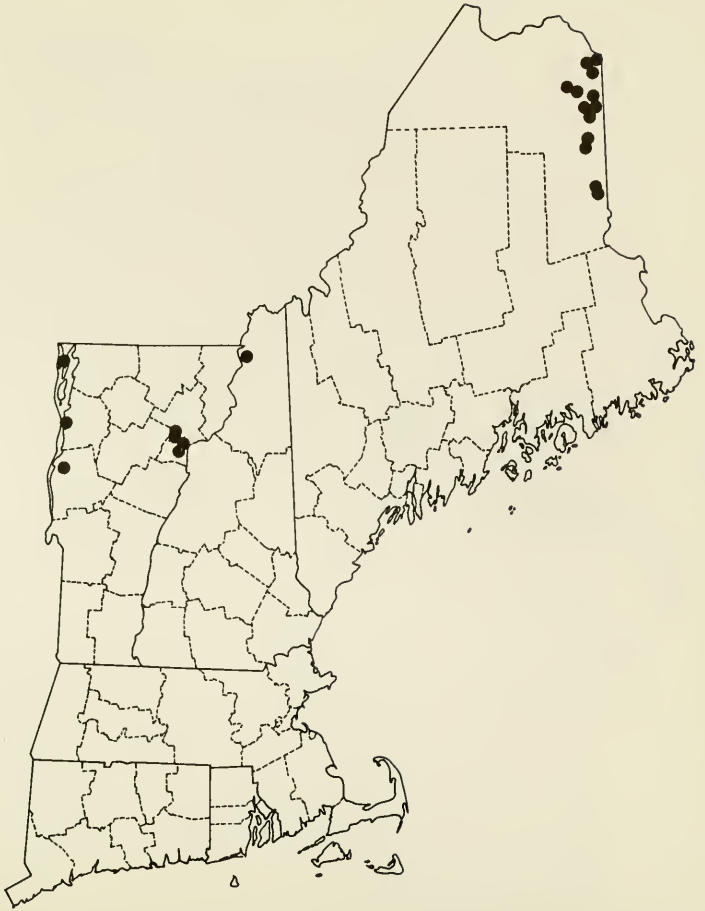


Figure 5.
Potamogeton filiformis var. alpinus: A. habit, broad-leaved plant. B. habit, narrow-leaved plant C. fruit. D-E. leaf bases and adnate stipules. F-H. leaf tip.



Map 5.
Potamogeton filiformis
var. alpinus

quite variable and in this treatment var. alpinus includes vars. borealis, filiformis and macounii of Fernald (1950). The larger-leaved plants reported by Hellquist (1975) as var. macounii appear to be var. alpinus as treated by Cronquist et al. (1977). Range extends from Greenland west to Alaska, south to northern New England, New York eastern Pennsylvania, Colorado, and Utah.

Rare and endangered plant lists: Maine, New Hampshire

alkalinity: mean 66.0 mg/l; range 24.0-88.0 mg/l
pH: mean 7.8; range 7.3-9.1

5. Potamogeton bicupulatus Fernald Fig. 6, Map 6

Abundant in acid waters along the coastal plain of New England. This species was treated as P. capillaceus Poir. in Fernald (1932, 1950) but Reznicek and Bobette (1976) refer it to P. bicupulatus in their treatment of section Hybridi. Range extends from Maine west to scattered locations in Michigan and Wisconsin, south to New Jersey, New York, Pennsylvania, Ohio, and northern Indiana; most abundant in New England.

alkalinity: mean 6.4 mg/l; range 1.5-21.0 mg/l
pH: mean 6.4; range 5.4-7.2

6. Potamogeton spirillus Tuckerman Fig. 7, Map 7

Abundant in acid to moderately alkaline waters throughout New England. This species is sometimes confused with P. bicupulatus and P. diversifolius. Plants are often found without floating leaves, but abundant fruit makes identification easy. Range extends from isolated locations in Newfoundland west to isolated sites in South Dakota, south to Delaware, eastern Ohio and Iowa; most abundant in New England and Middle Atlantic States.

alkalinity: mean 16.2 mg/l; range 2.5-57.5 mg/l
pH: mean 7.0; range 5.9-10.2

7. Potamogeton diversifolius Raf. Fig. 8, Map 8

Rare, known from only four locations in Massachusetts and Connecticut. This species reaches the northeast extreme of its range in New England. These New England populations occur in acid waters as compared to the more alkaline waters further west. Range extends from Massachusetts west to Pennsylvania, northern Ohio, Illinois, Minnesota, Montana and Oregon, south to Florida, Texas, California, and Mexico; most abundant in the southeast. This species should be included on revised rare and endangered plant lists of Massachusetts and Connecticut.

alkalinity: mean 2.0 mg/l
pH: mean 6.6

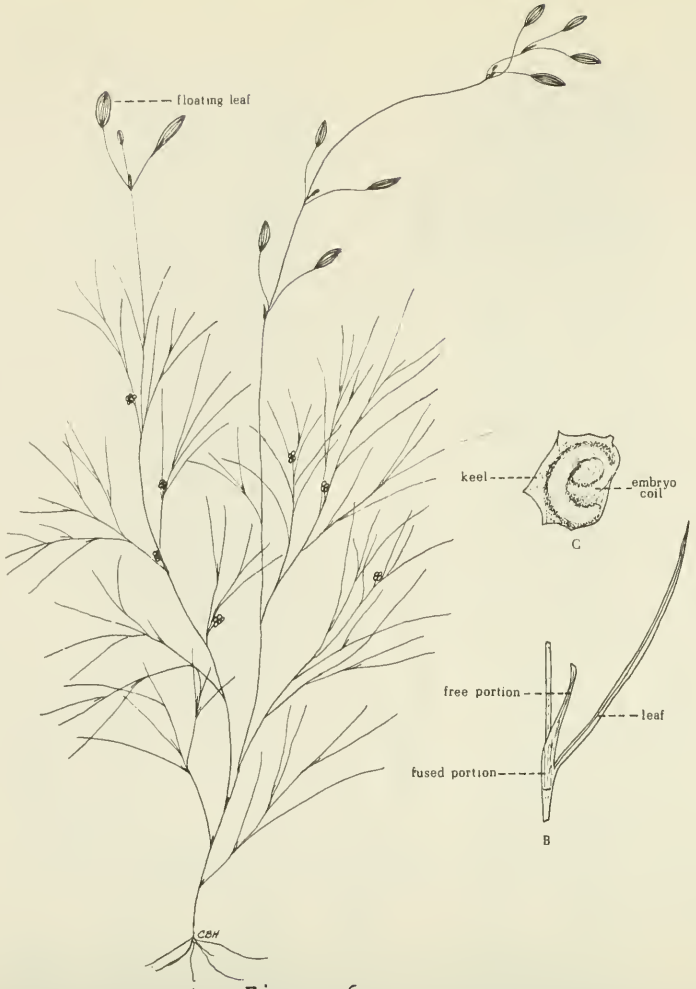
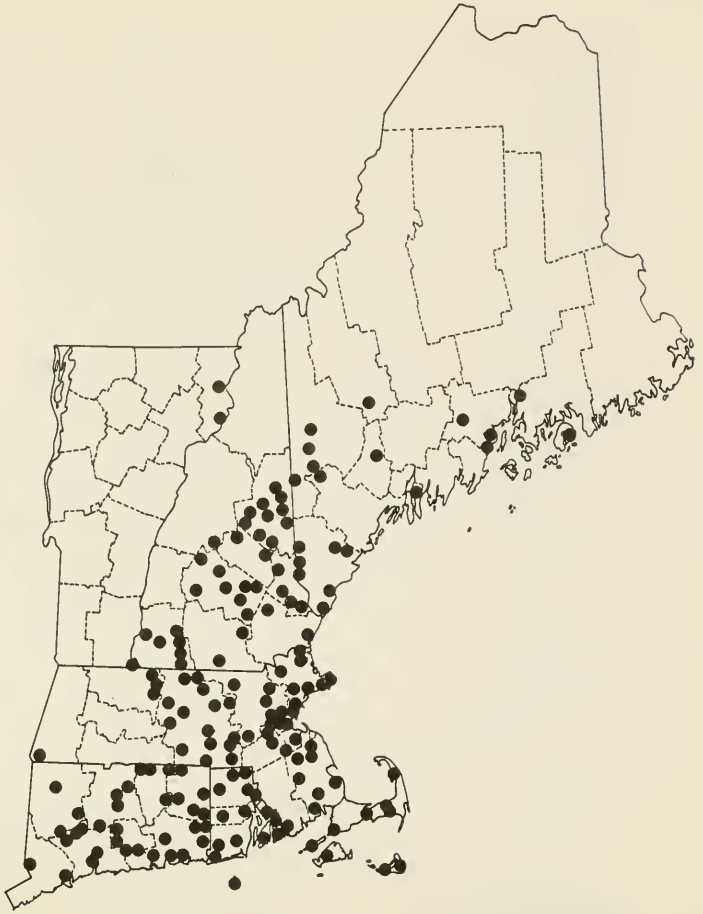


Figure 6.
Potamogeton bicupulatus: A. habit. B. leaf base and adnate stipule. C. fruit.



Map 6.
Potamogeton bicupulatus

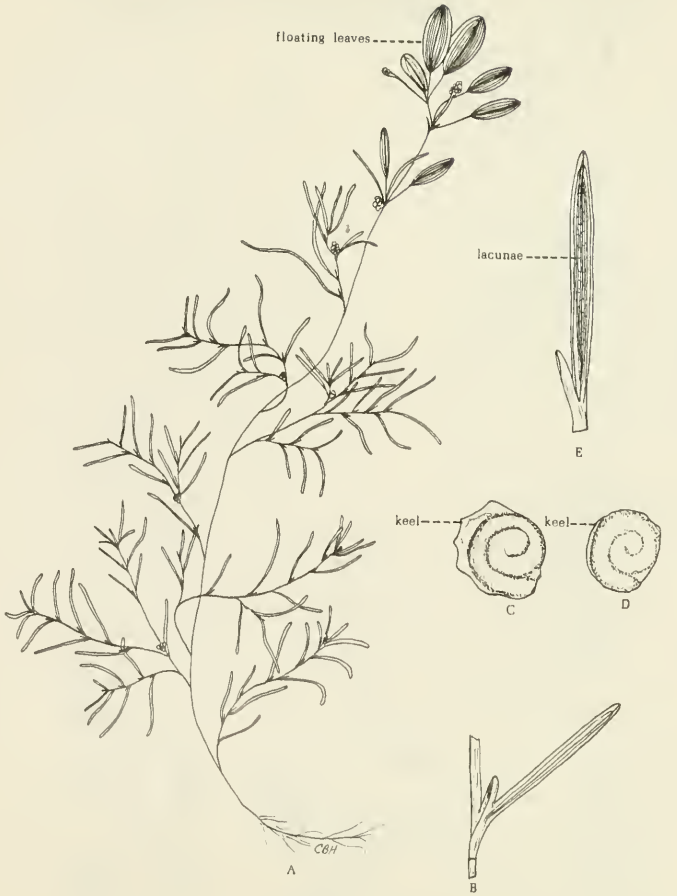
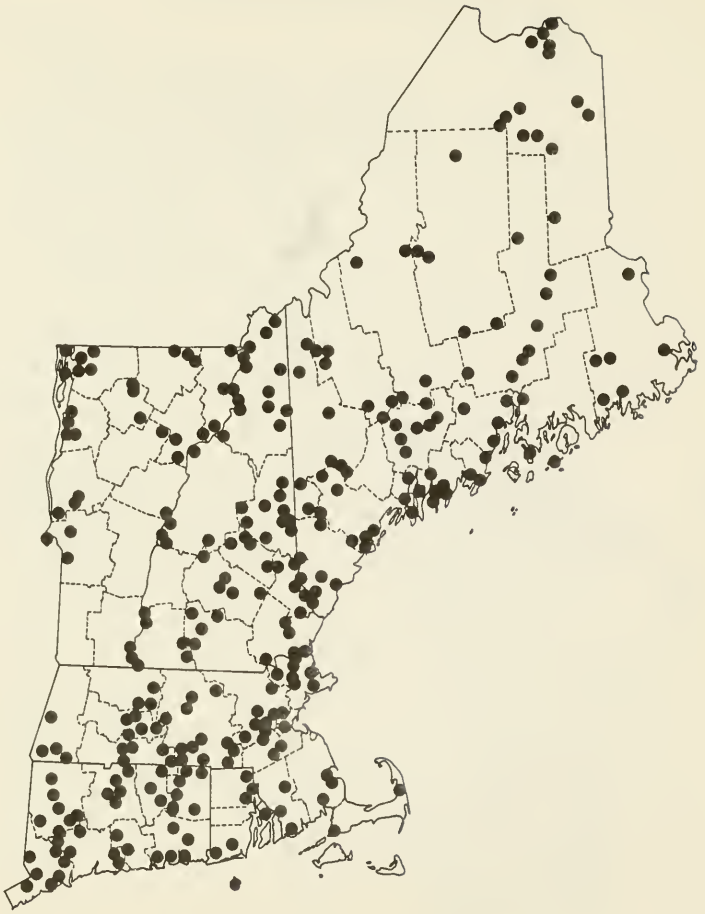
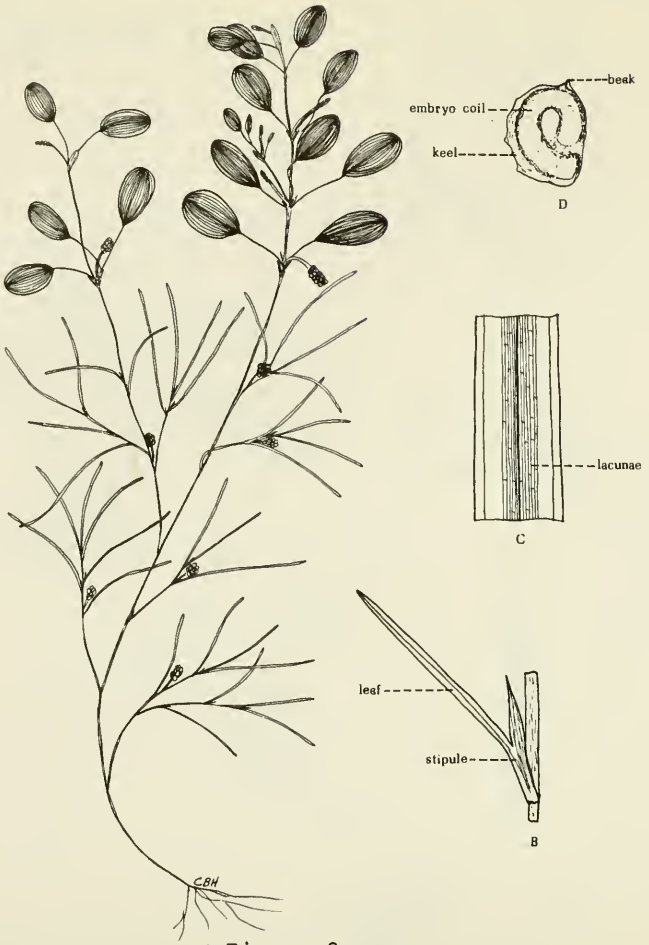


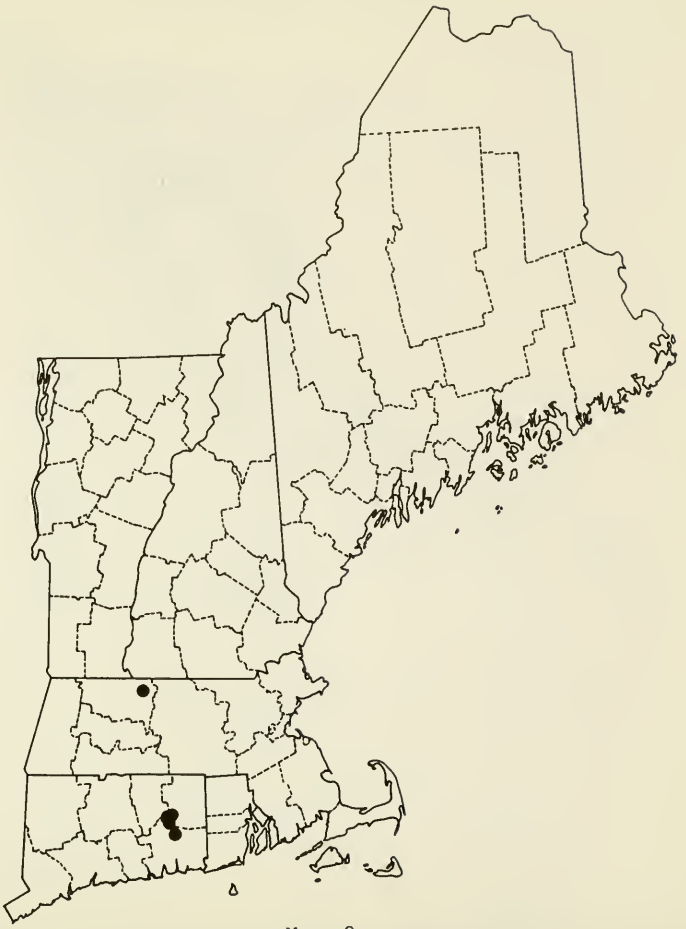
Figure 7.
Potamogeton spirillus: A. habit. B. leaf base and adnate stipule. C-D. fruit. E. leaf.



Map 7.
Potamogeton spirillus



^ Figure 8.
Potamogeton diversifolius: A. habit. B. leaf base and adnate stipule. C. portion of leaf. D. fruit.



Map 8.
Potamogeton diversifolius

8. Potamogeton epihydrus Raf. Figs. 9, 10, Maps 9, 10

Abundant throughout New England in acid and alkaline waters. Two varieties are recognized: the ubiquitous var. ramosus [var. nuttallii of Fernald, (1950)] and the uncommon variety epihydrus from alkaline waters of western and northern New England. Only the extremes of these two varieties are easy to distinguish. Range extends from Newfoundland and Labrador west to southern Manitoba, and southern Alaska, south to western North Carolina, Tennessee, northern Mississippi, Colorado, and California; most abundant in the northeast.

Leaves 5-10 mm broad, 7-13-veined; fruit 3-4.5 mm long, 3-3.6 mm broad.
..... var. epihydrus
Leaves 1-8 mm broad, (3) 5-7-veined; fruit 2.5-3.5 mm long, 2-3 mm broad.
..... var. ramosus (Peck) House

variety ramosus

alkalinity: mean 20.1 mg/l; range 2.0-245.0 mg/l
pH: mean 6.8; range 5.0-9.5

variety epihydrus

alkalinity: mean 62.5 mg/l; range 9.0-120.0 mg/l
pH: mean 7.5; range 6.8-8.6

9. Potamogeton confervoides Reichenb. Fig. 11, Map 11

Found in acid waters of New England along the coastal plain and in high elevation lakes and ponds. This species is found in waters of the greatest acidity in New England. The pH may be as low as 5.0 and the alkalinity can approach 0.0 mg/l. Potamogeton confervoides may be overlooked if not in fruit as it blends in with Eleocharis acicularis, E. robbinsii and Scirpus subterminalis, with which it is often associated. Range extends from Newfoundland west to the Upper Peninsula of Michigan and eastern Wisconsin, south to southern New Jersey, Pennsylvania, and North Carolina.

Rare and endangered plant list: Maine, Vermont, Connecticut

alkalinity: mean 3.6 mg/l; range 0.5-7.0 mg/l
pH: mean 6.3; range 5.3-6.8

10. Potamogeton zosteriformis Fernald Fig. 12, Map 12

Scattered throughout New England with population concentrations in regions of higher alkalinity, particularly along the western border. Range extends from the Gaspé Peninsula of Quebec west to Manitoba, south to northern Virginia, southern Ohio and Nebraska; a minor range extension occurs from western Montana to British Columbia; south to Oregon; isolated populations in northern Alberta and northern California.

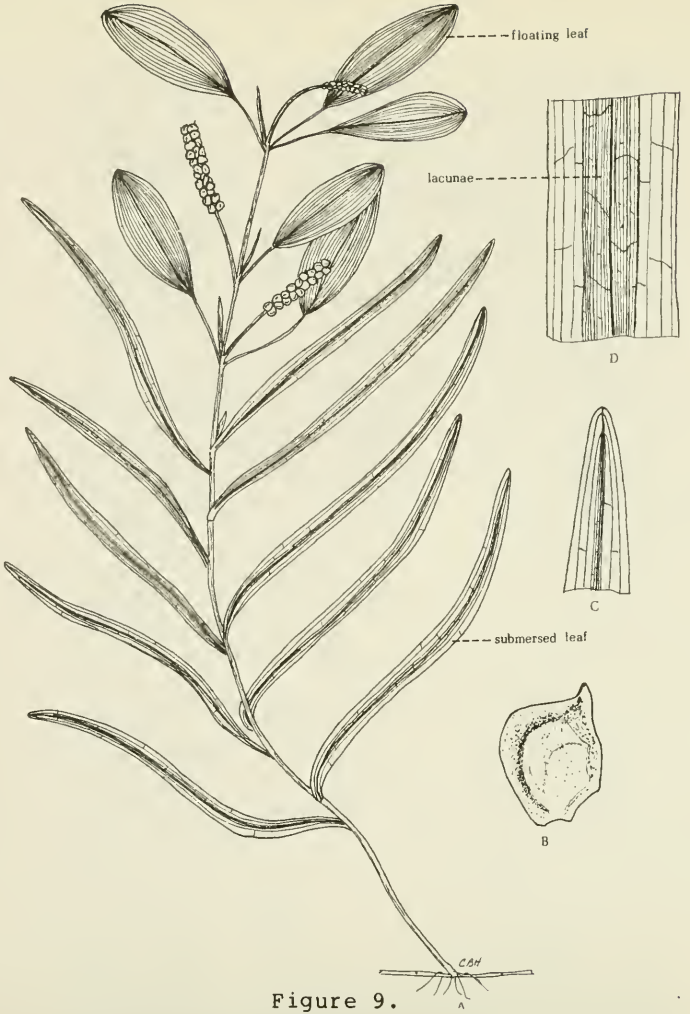
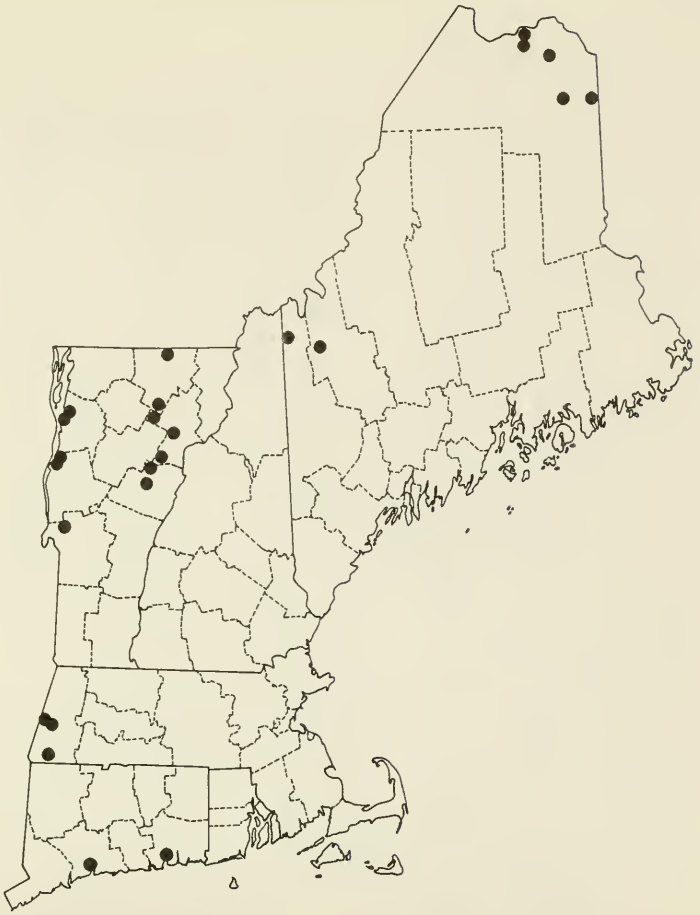


Figure 9.
Potamotegon epihydrus var. epihydrus: A. habit. B. fruit. C. leaf tip. D. portion of leaf.



Map 9.
Potamogeton epihydrus
var. epihydrus

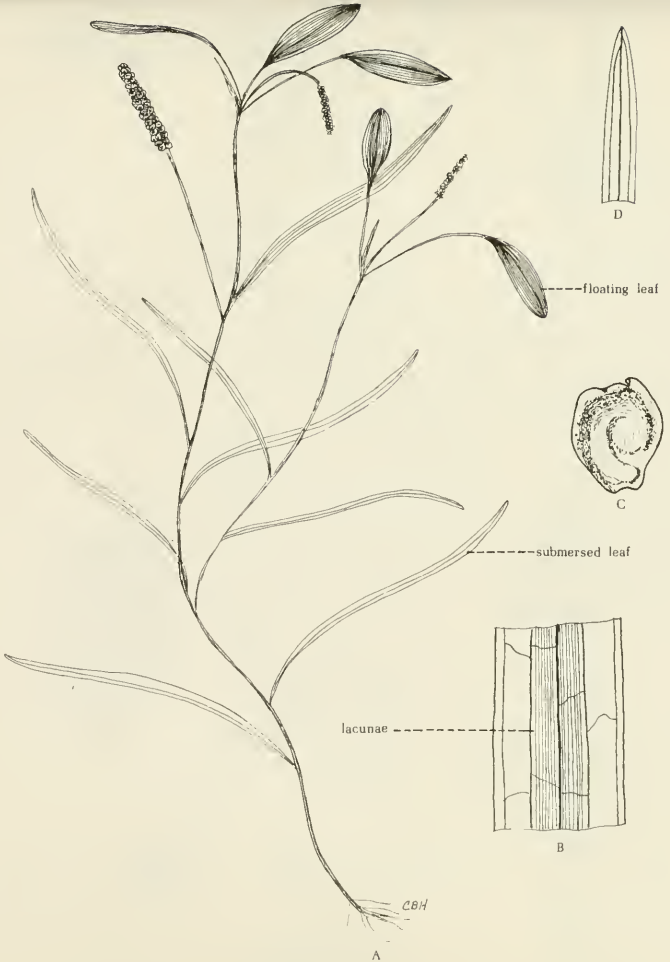
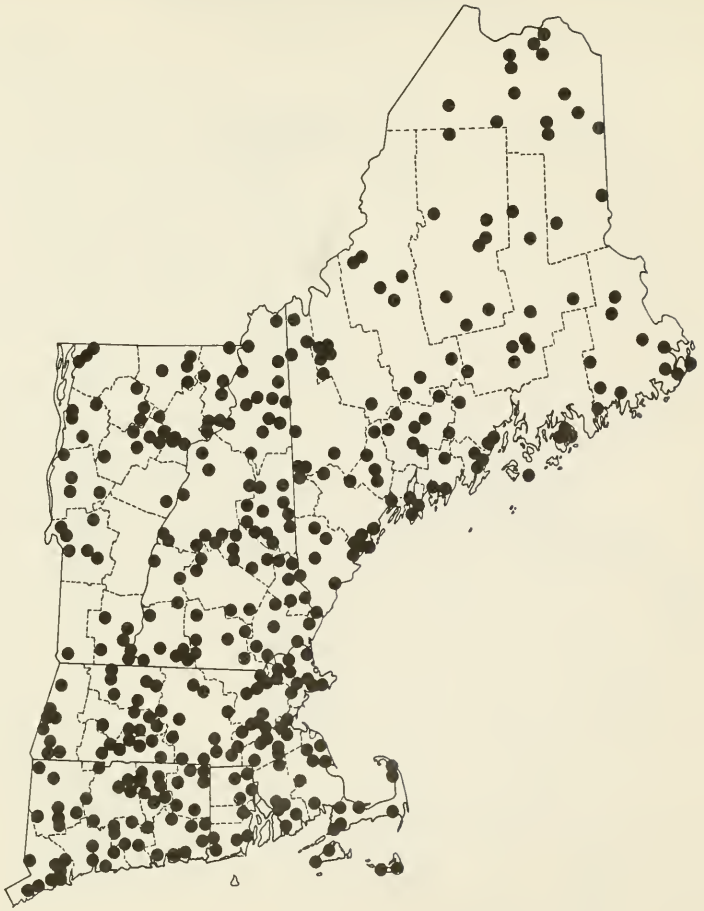


Figure 10.
Potamogeton epihydrus var. ramosus: A. habit. B. portion of leaf. C. fruit. D. leaf tip.



Map 10.
Potamogeton epihydrus
var. ramosus

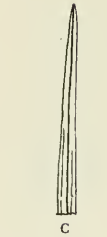
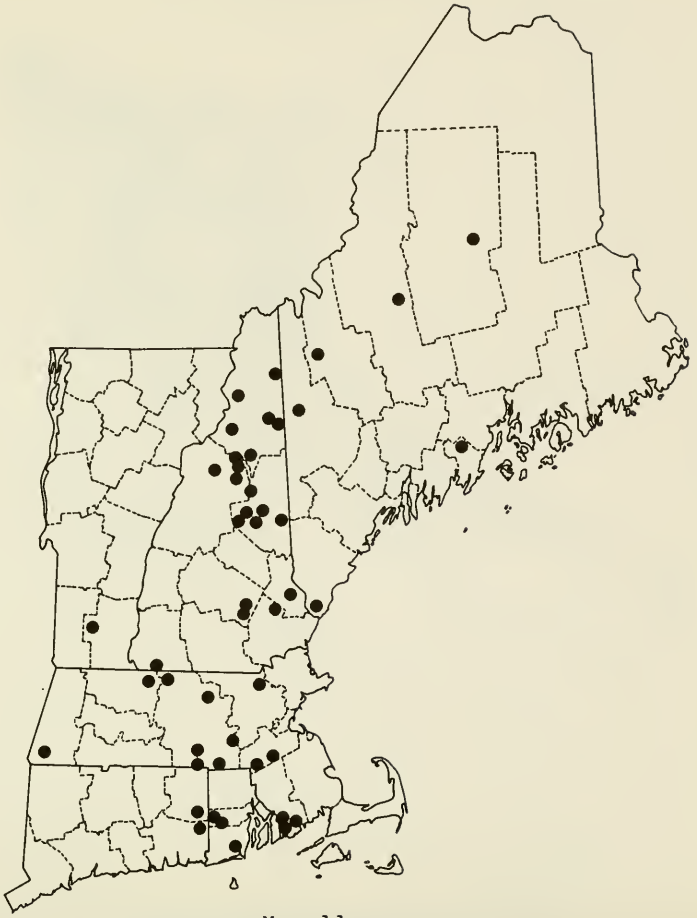


Figure 11.
Potamogeton confervoides: A. habit. B. fruit. C. leaf tip.



Map 11.
Potamogeton confervoides

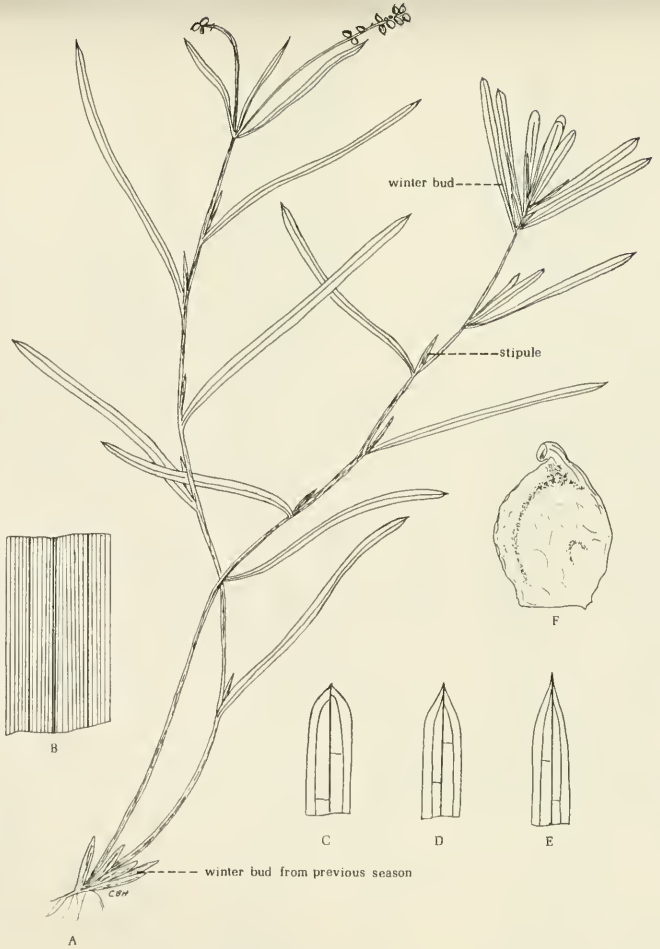
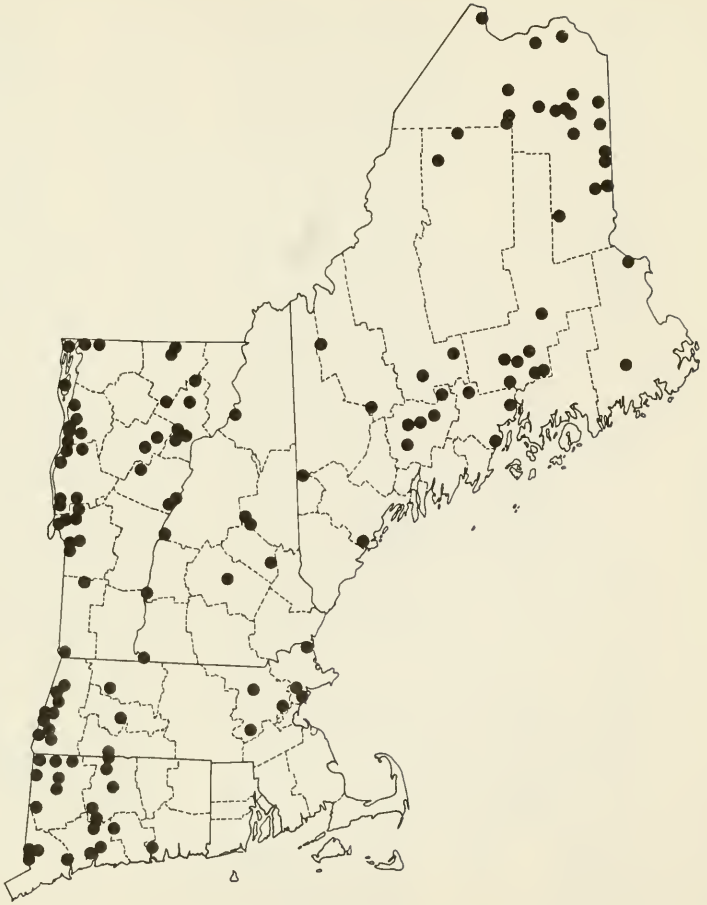


Figure 12.
Potamogeton zosteriformis: A. habit. B. portion of leaf. C-E. leaf tips. F. fruit.



Map 12.
Potamogeton zosteriformis

Rare and endangered plant list: New Hampshire, although frequent along the Connecticut River.

alkalinity: mean 50.9 mg/l; range 4.5-123.5
pH: mean 7.5; range 5.8-10.2

11. Potamogeton hillii Morong Fig. 13, Map 13

Uncommon in highly alkaline ponds and streams of western New England with the exception of being locally abundant at numerous locations in Berkshire County, Massachusetts. Prior to 1972 this species was known only from five locations in New England. Extensive field work has shown it to be more abundant. Range extends from Vermont to northwestern Connecticut, west to southern Ontario, northern Michigan, south to Pennsylvania, New York, and eastern Ohio; most abundant in western New England, eastern New York and northern Michigan.

Rare and endangered plant list: Vermont, Massachusetts

alkalinity: mean 141.5 mg/l; range 86.0-290.0 mg/l
pH: mean 7.5; range 7.2-8.2

12. Potamogeton foliosus Raf. Fig. 14, Map 14

Common in alkaline waters of northeastern Maine, Vermont, western Massachusetts and Connecticut; scattered elsewhere. The treatment of this species follows that of Haynes (1974) which does not recognize the narrow-leaved variety macellus as distinct. In New England this species is predominantly narrow-leaved. Range extends throughout North America from Nova Scotia west to central Alaska, south to Jamaica and Guatamala; most abundant in northeastern United States and the Great Lakes States.

alkalinity: mean 73.5 mg/l; range 14.0-290.0 mg/l
pH: mean 7.8; range 6.5-9.8

13. Potamogeton friesii Rupr. Fig. 15, Map 15

Uncommon to rare in alkaline waters of Aroostook County, Maine and western New England. The single eastern Massachusetts population has long been extinct. Range extends from western Newfoundland and Labrador west to central Alaska, south to Pennsylvania, western Nebraska, and Utah; most abundant in the Great Lakes region.

Rare and endangered plant lists: Massachusetts, Connecticut, Vermont

alkalinity: mean 71.2 mg/l; range 35.0-123.5 mg/l
ph: mean 8.0; range 7.0-9.8

14. Potamogeton strictifolius Benn. Fig. 16, Map 16

Uncommon in alkaline waters of Aroostook County, Maine and numerous locations in western New England. The treatment of

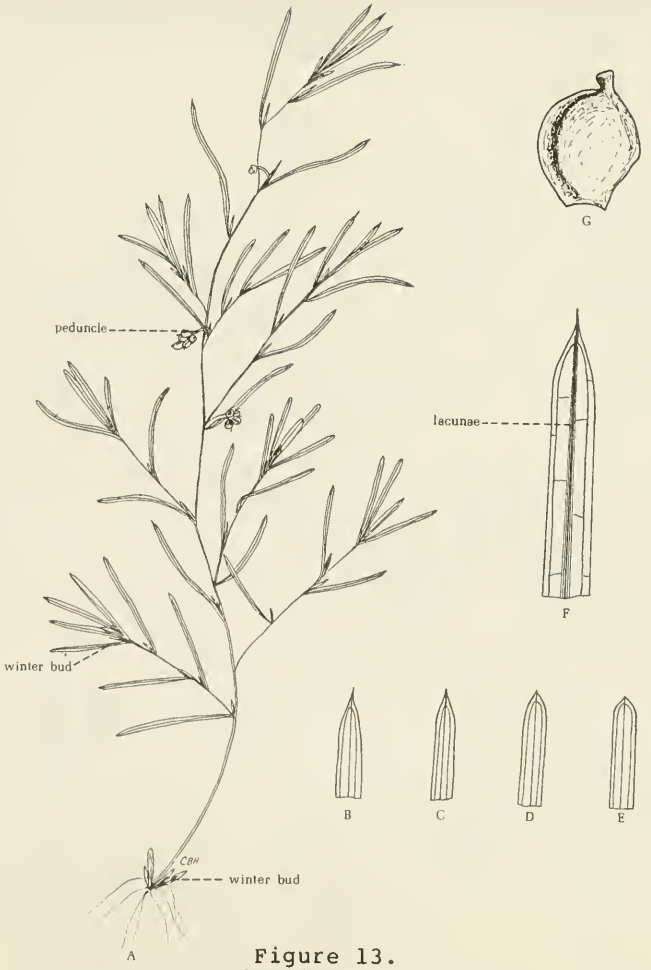
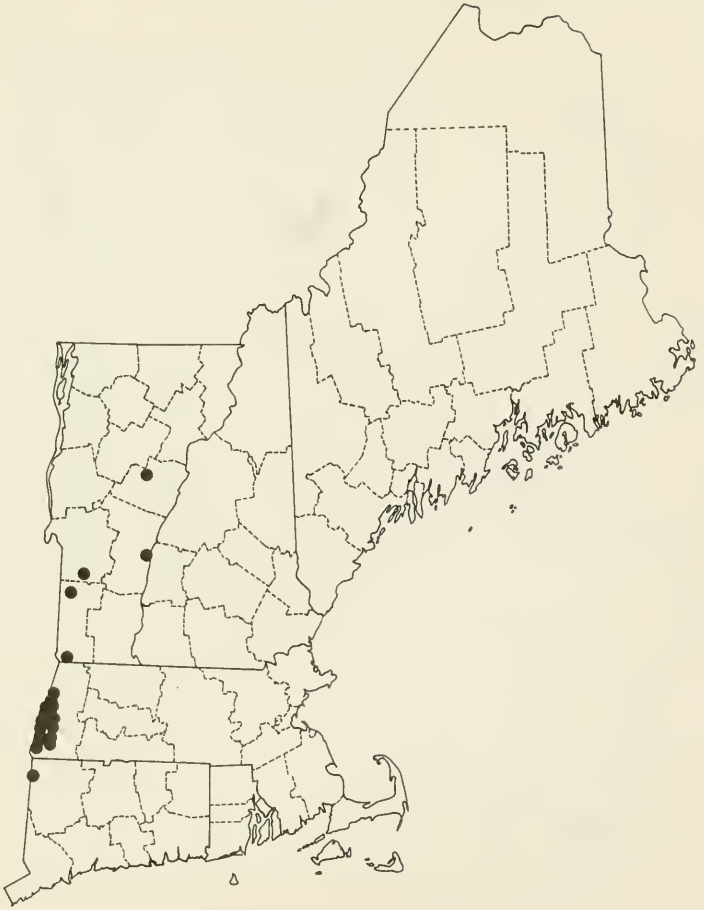
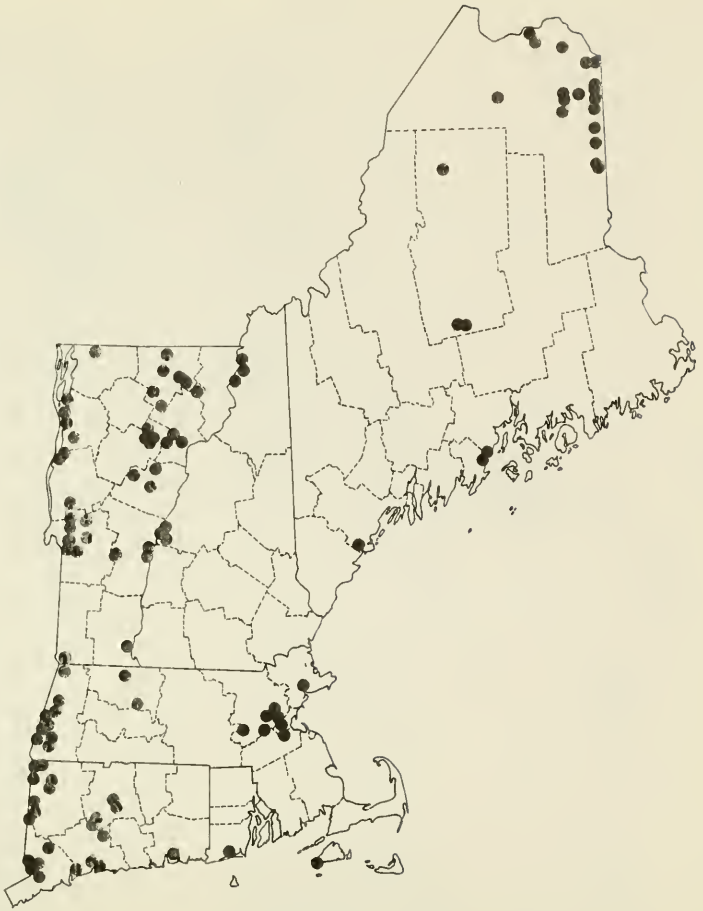


Figure 13.
Potamogeton hillii: A. habit. B-E. leaf tips. F. leaf. G. fruit.



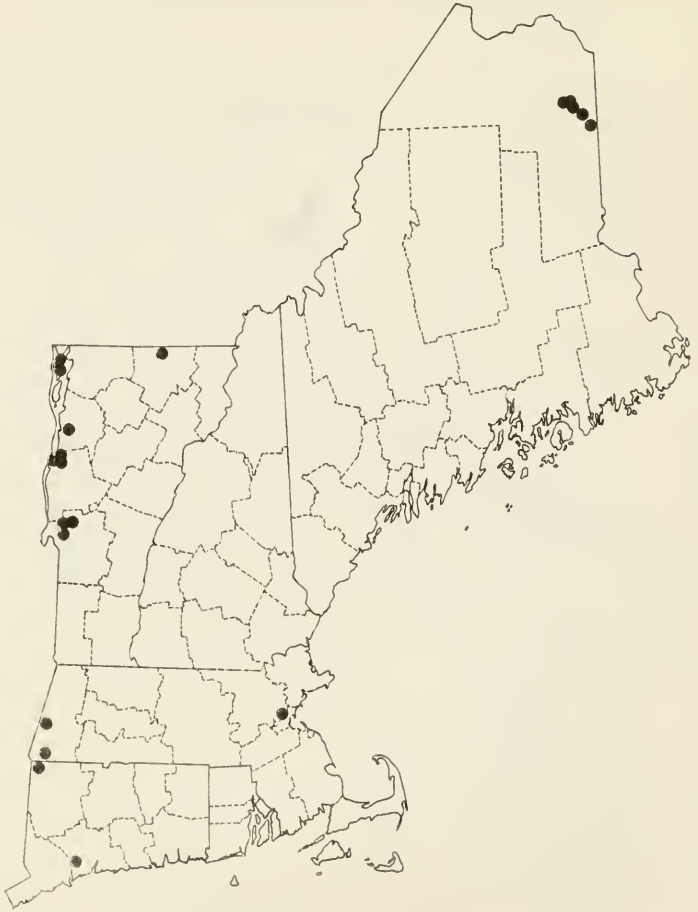
Map 13.
Potamogeton hillii

Figure 14.
Potamogeton foliosus: A. habit. B. fruit. C. leaf base. D. leaf.



Map 14.
Potamogeton foliosus

Figure 15.
Potamogeton friesii: A. habit. B. fruit. C. leaf tip. D. leaf base.



Map 15.
Potamogeton friesii

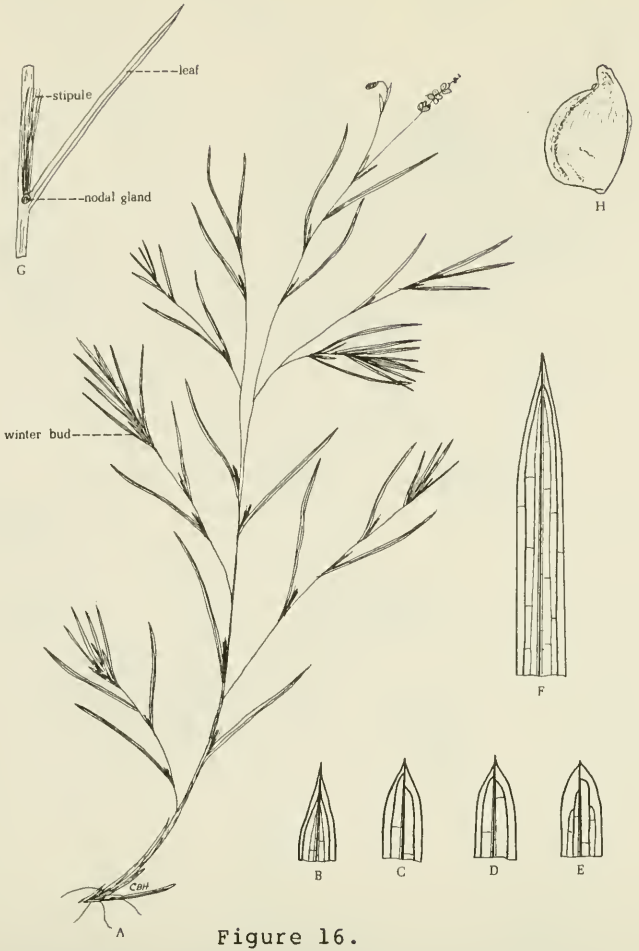
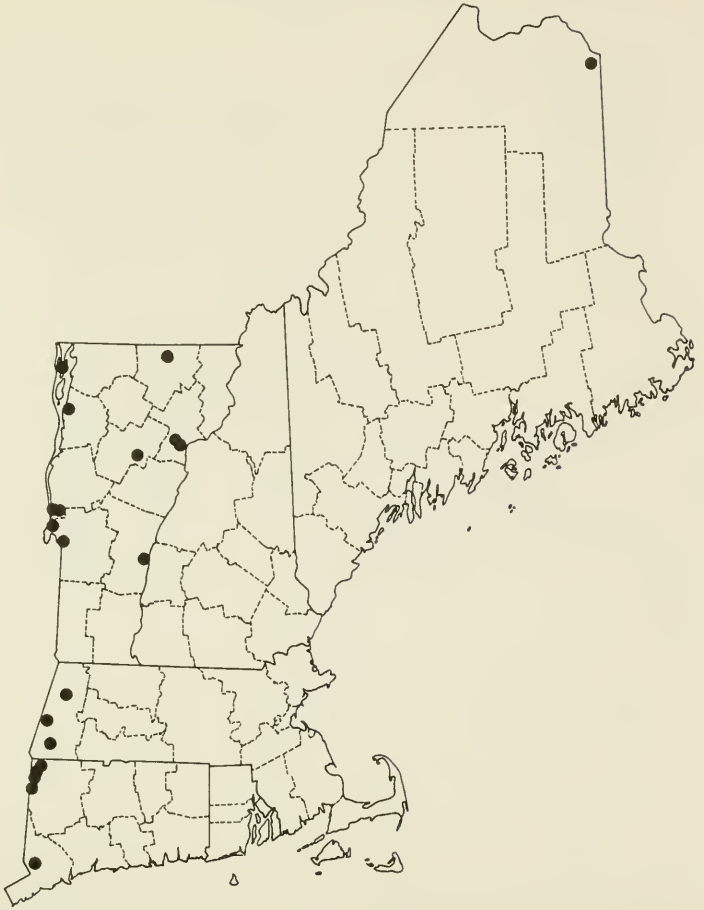


Figure 16.
Potamogeton strictifolius: A. habit. B-E. leaf tips. F. leaf. G. leaf base. H. fruit.



Map 16.
Potamogeton strictifolius

this species follows Haynes (1974) who does not recognize infraspecific taxa due to the range of variability observed both between and within populations. Hybrids between this species and P. zosteriformis may be called P. X longiligulatus Fernald (Haynes and Williams, 1975). Range extends from eastern Quebec to the Northwest Territories, south to northwest Connecticut, New York, Indiana, Minnesota, Nebraska, Wyoming and northern Utah; most abundant in the Great Lakes region.

Rare and endangered plant lists: Massachusetts, Connecticut

alkalinity: mean 76.1 mg/l; range 55.0-109.0 mg/l
pH: mean 7.5; range 7.0-8.4

15. Potamogeton obtusifolius Mert. and Koch Fig. 17, Map 17

Widely scattered throughout New England in still waters of moderate alkalinity. Recent records show this species to be most abundant in Aroostook County, Maine and northeastern Vermont. Range extends from Labrador west to the Yukon Territory, south to New England, New Jersey, New York, northern Michigan, Wisconsin, and Minnesota; an isolated station in northwest Wyoming; most abundant in northeastern states.

alkalinity: mean 49.1 mg/l; range 13.5-104.5 mg/l
pH: mean 7.4; range 6.7-8.2

16. Potamogeton pusillus L. var. pusillus Fig. 18, Map 18

Uncommon in northeastern Maine, abundant in western New England in alkaline waters. Includes both var. pusillus and var. minor of Fernald (1950). Range extends throughout North America from Newfoundland and Labrador west to Northwest Territories and Alaska, south to Mexico and Guatemala.

alkalinity: mean 64.1 mg/l; range 25.0-114.5 mg/l
pH: mean 8.1; range 7.3-10.2

17. Potamogeton pusillus L. var. tenuissimus Mert. and Koch Fig. 19, Map 19

Extremely common in acid and alkaline waters throughout New England; occasionally in brackish water along the coast. Includes all varieties of P. berchtoldii Fieber (Haynes, 1974) as treated by Fernald (1950). Range extends from Newfoundland to Alaska, south to northern Florida, Louisiana, and California; most abundant in the northeast.

alkalinity: mean 32.4 mg/l; range 2.5-179.0 mg/l
pH: mean 7.1; range 5.6-10.2

18. Potamogeton pusillus L. var. gemmiparus Robbins Fig. 20, Map 20

Uncommon in acid waters of eastern New England. Treated by Fernald (1932) as P. gemmiparus (Robbins) Morong; however, Haynes (1974) recognized it as a variety of P. pusillus. This

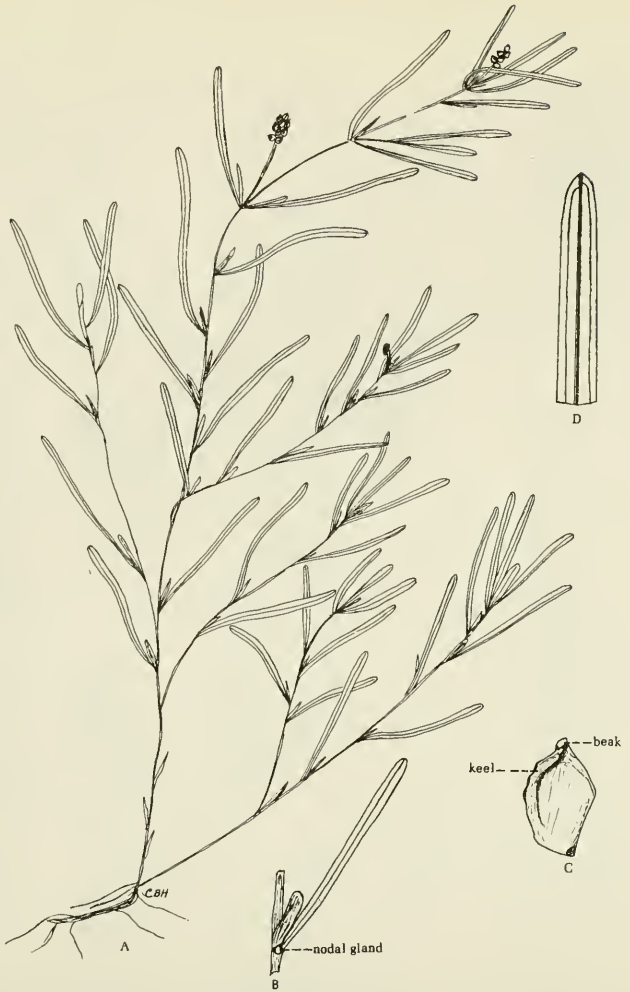
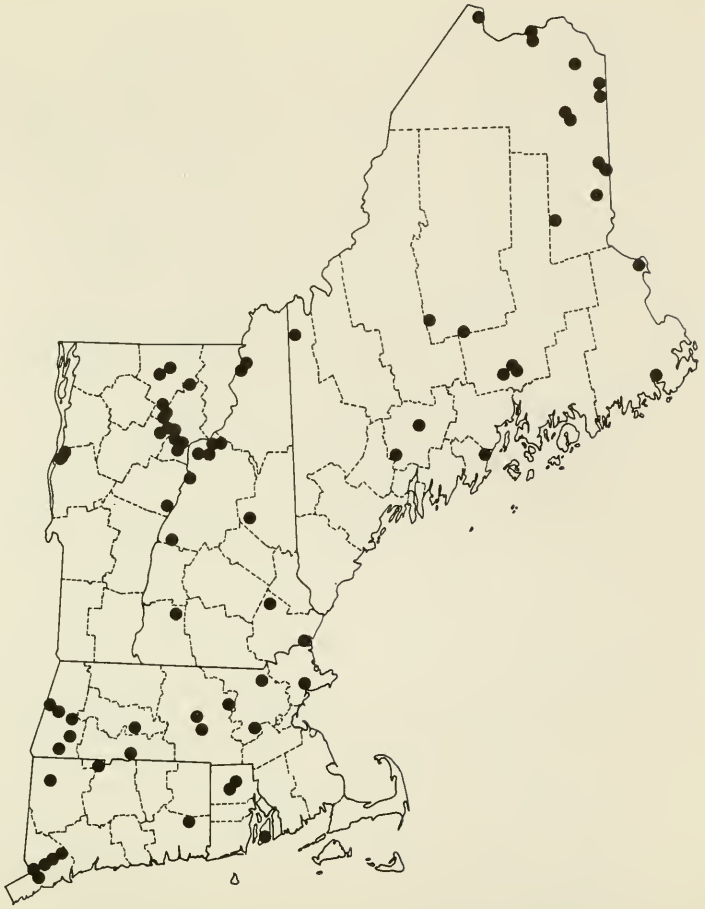


Figure 17.
Potamogeton obtusifolius: A. habit. B. leaf base. C. fruit. D. leaf tip.



Map 17.
Potamogeton obtusifolius

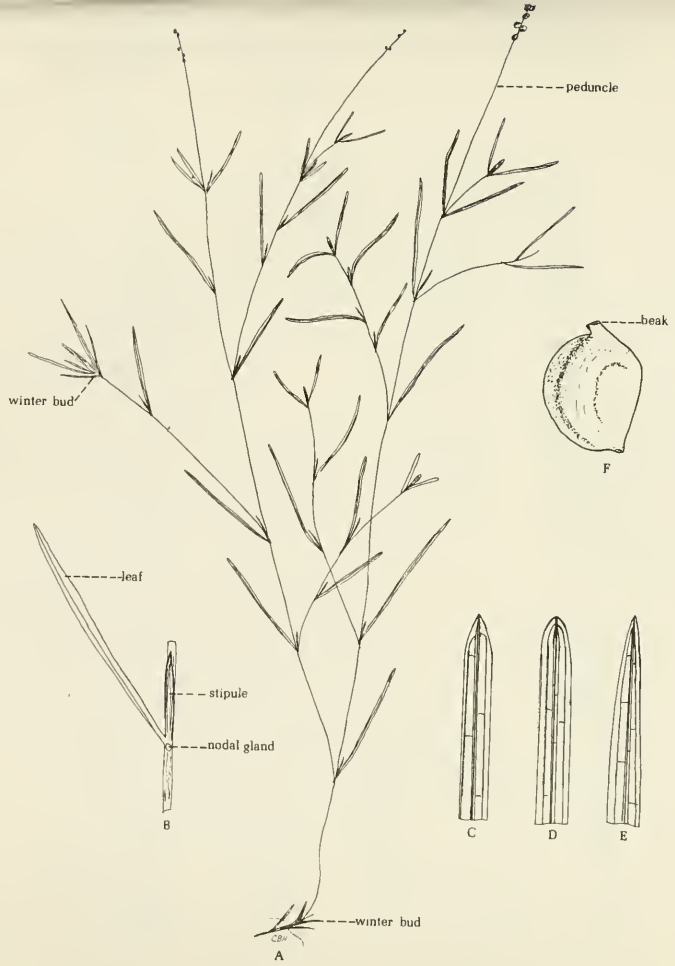
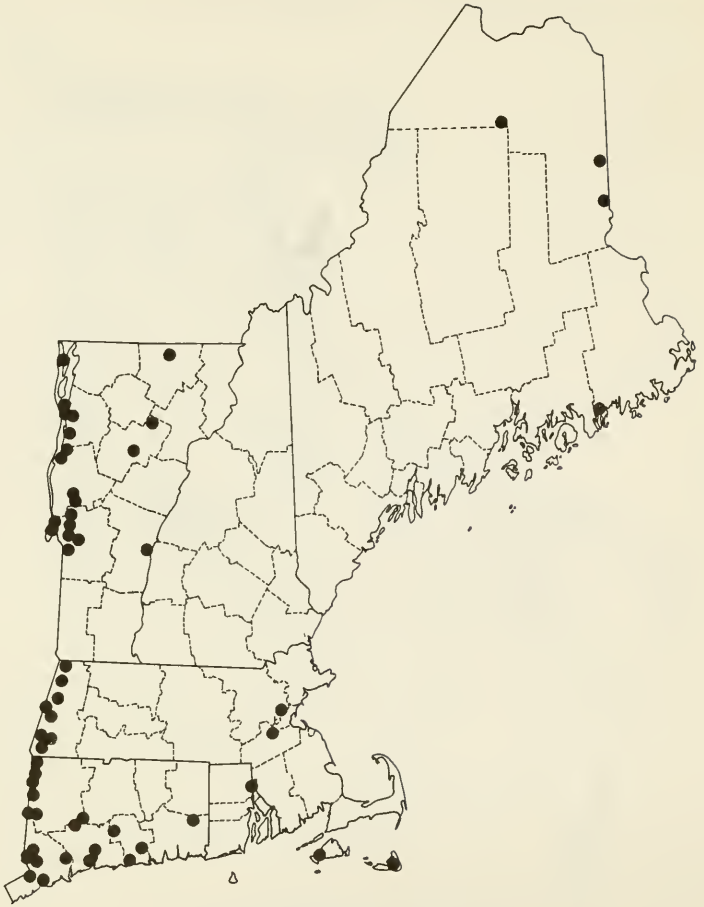


Figure 18.
Potamogeton pusillus var. pusillus: A. habit. B. leaf base. C-E. leaf tips. F. fruit.



Map 18.
Potamogeton pusillus
var. pusillus

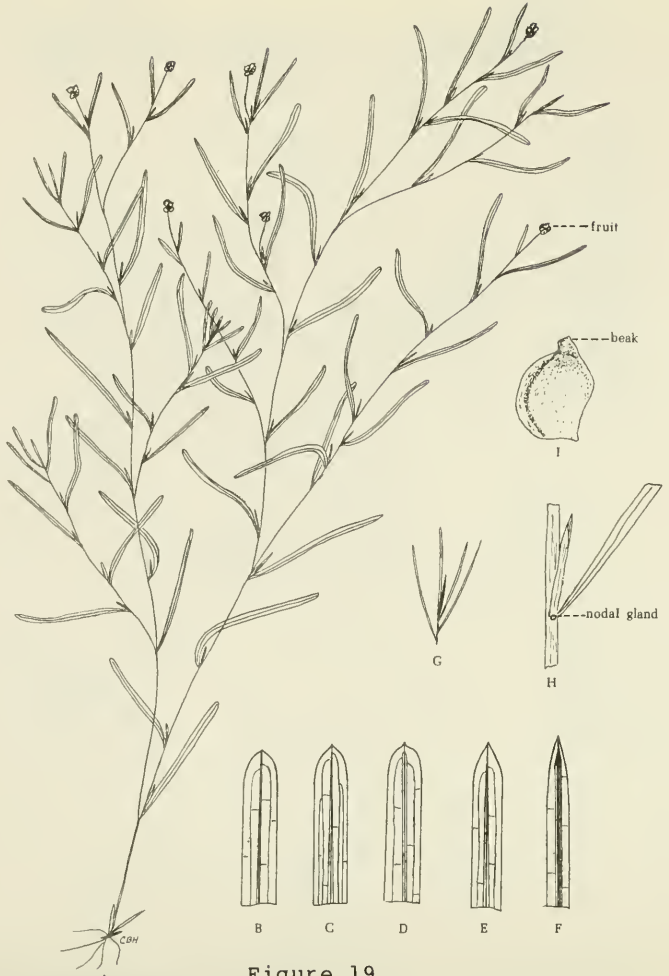
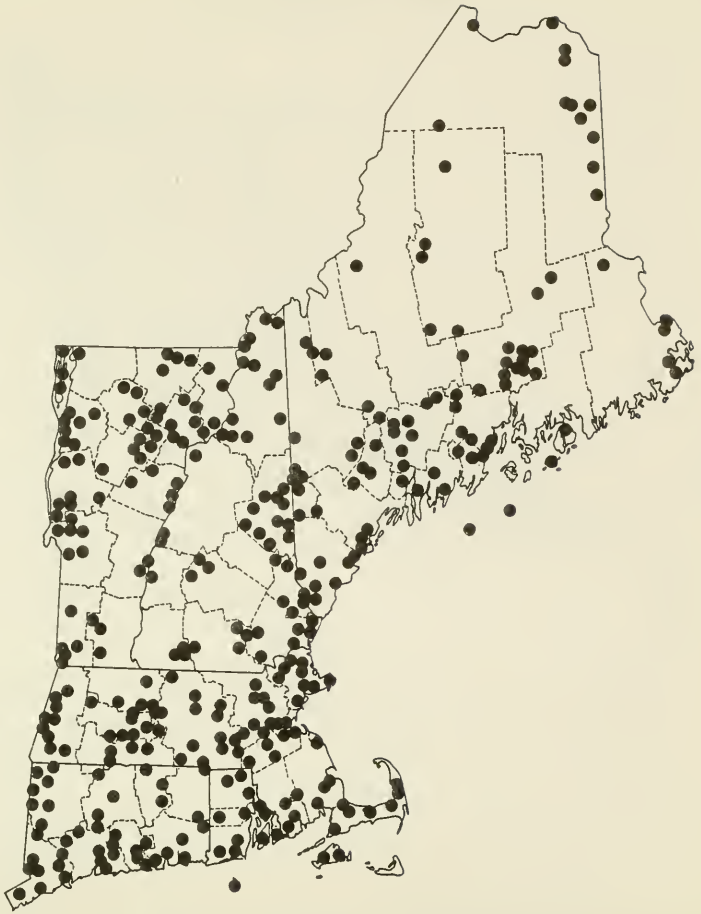


Figure 19.
Potamogeton pusillus var. tenuissimus:
A. habit. B-F. leaf tips. F. fruit.
G. winter bud. H. leaf base I. fruit.



Map 19.
Potamogeton pusillus
var. tenuissimus

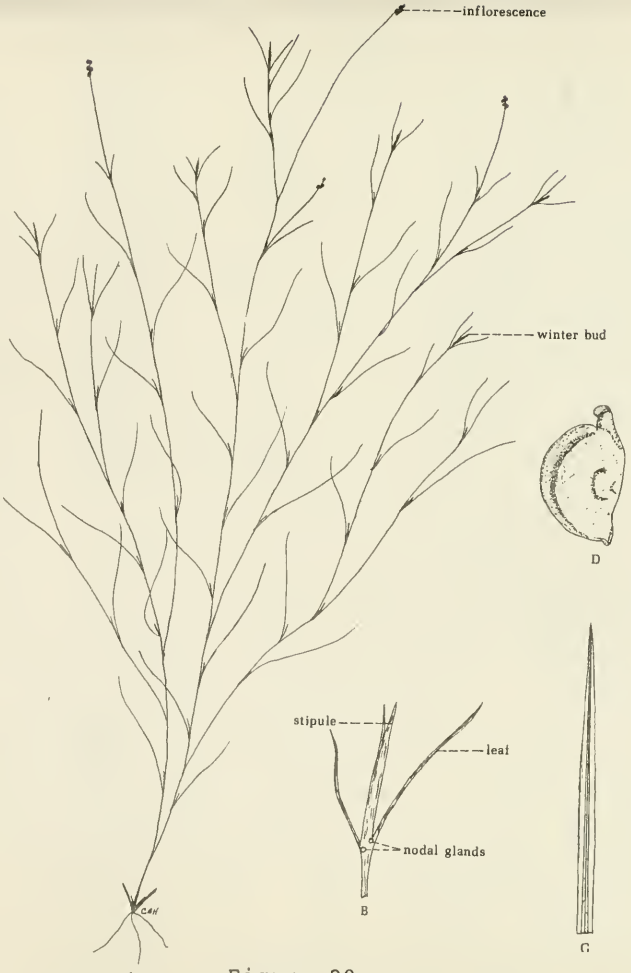
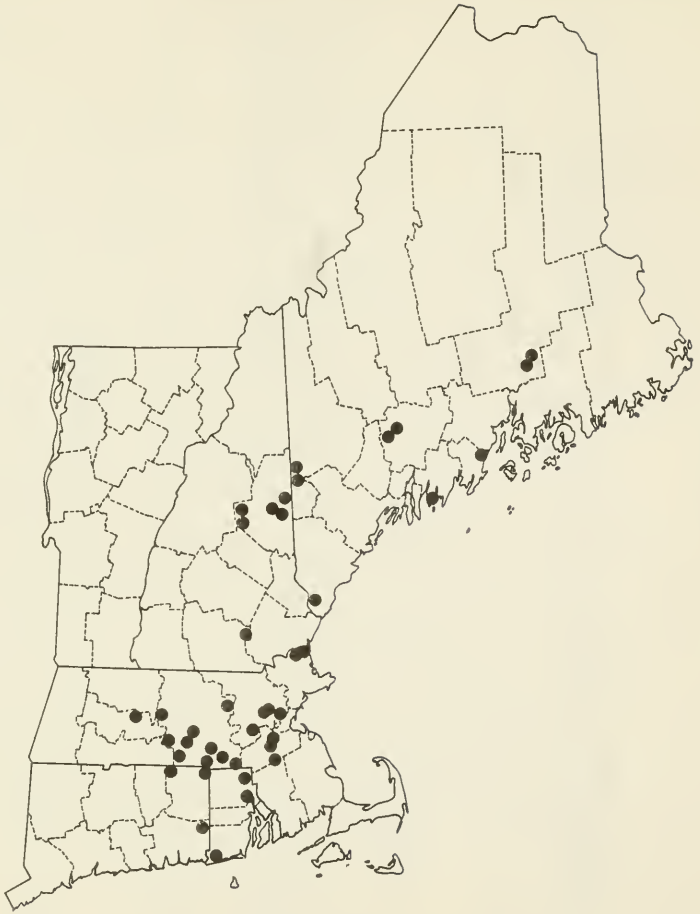


Figure 20.
Potamogeton pusillus var. gemmiparus: A. habit. B. winter bud. C. leaf tip. D. fruit.



Map 20.
Potamogeton pusillus
var. gemmiparus

narrow-leaved variety, which rarely sets fruit, was originally described from Uxbridge, Massachusetts. Range extends out of New England to one locality in southeastern Quebec.

Rare and endangered plant lists: New Hampshire, Connecticut

alkalinity: mean 9.4 mg/l; range 2.5-17.0
pH: mean 6.7; range 6.3-7.1

19. Potamogeton vaseyi Robbins Fig. 21, Map 21

Uncommon at widely scattered locations in moderately alkaline waters throughout New England. Plants without floating leaves are easily confused with P. pusillus var. gemmiparus. Range extends from New Brunswick west to Wisconsin, south to Connecticut, Pennsylvania, northeastern Ohio, Michigan, northern Illinois, Wisconsin, and Minnesota.

Rare and endangered plant lists: Maine, New Hampshire, Connecticut

alkalinity: mean 24.5 mg/l; range 7.0-55.0 mg/l
pH: mean 7.2; range 6.7-7.6

20. Potamogeton lateralis Morong Fig. 22, Map 22

Extremely rare, known in New England from five localities. Only the New Hampshire and Vermont locations have been documented since 1880. The Vermont population is of interest since the plants grow mixed with the similar P. vaseyi. However, the fruits differ and the spatulate floating leaves of P. lateralis are distinctive. The Danbury, Connecticut populations documented in various herbaria which have been identified as P. lateralis var. sigmoides Eames are P. pusillus var. tenuissimus. Range extends from New Hampshire and Vermont south to Massachusetts and northeastern Connecticut; widely scattered locations in New York, Michigan, and eastern Minnesota. This species may be overlooked due to its similarity to P. vaseyi.

Rare and endangered plant lists: New Hampshire, Vermont, Massachusetts, Connecticut

alkalinity: mean 34.5 mg/l; range 13.5-55.0 mg/l
pH: mean 6.6; range 6.4-6.7

21. Potamogeton natans L. Fig. 23, Map 23

Extremely common in New England. Range extends from Newfoundland to Alaska, south to New Jersey, northern Indiana, Nebraska, Colorado, Arizona, and southern California; reported from one location in North Carolina where it evidently was a short-lived introduction.

alkalinity: mean 36.7 mg/l; range 2.5-245.0 mg/l
pH: mean 7.1; range 5.0-9.8

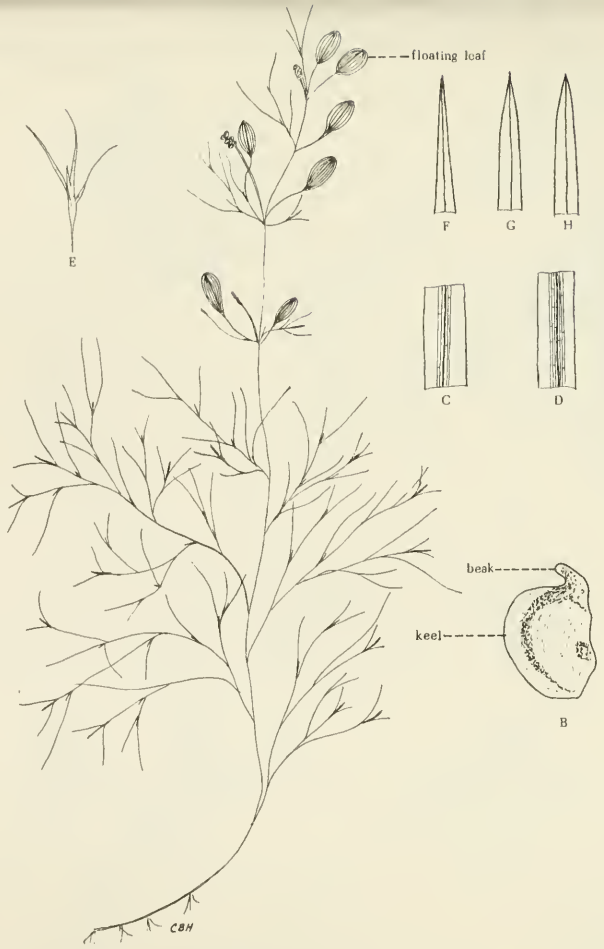
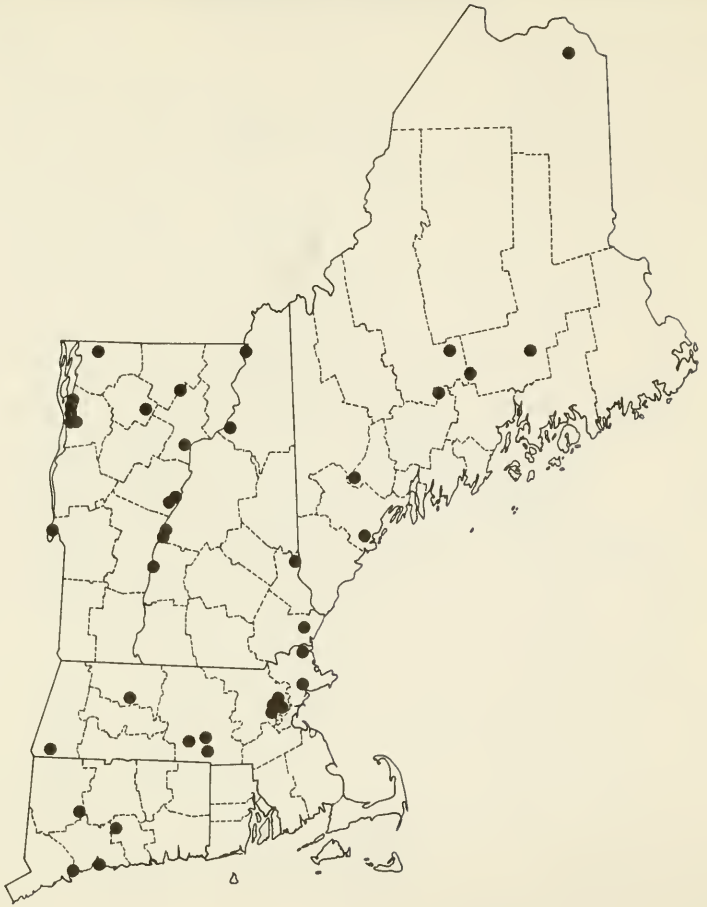


Figure 21.
Potamogeton vaseyi: A. habit. B. fruit. C-D. portions of leaves. E. winter bud. F-H. leaf tips.



Map 21.
Potamogeton vaseyi

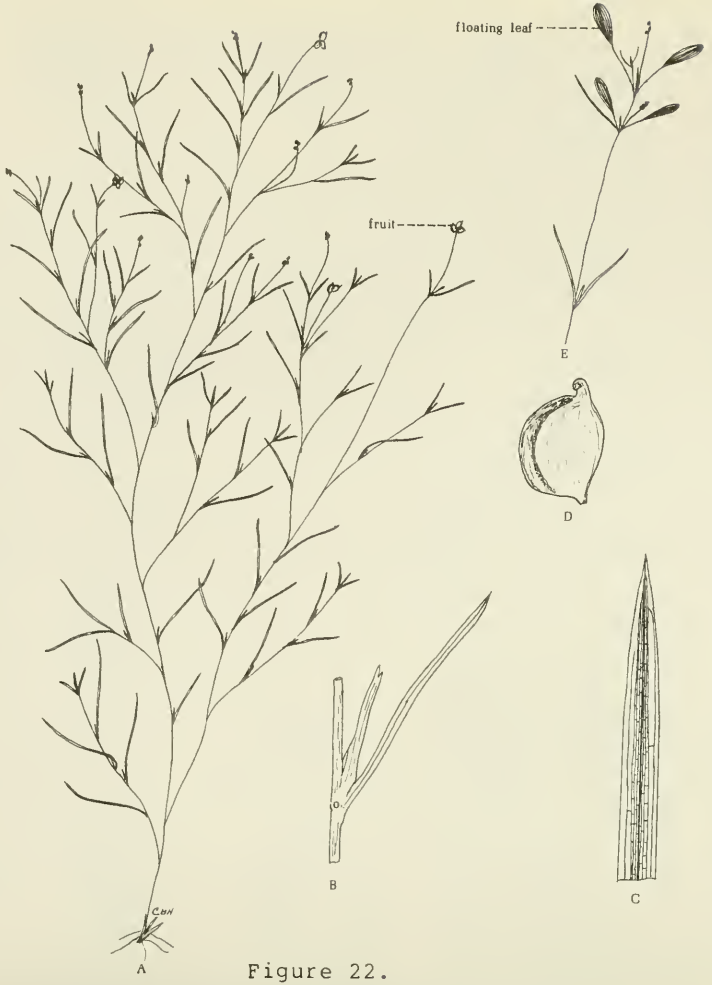
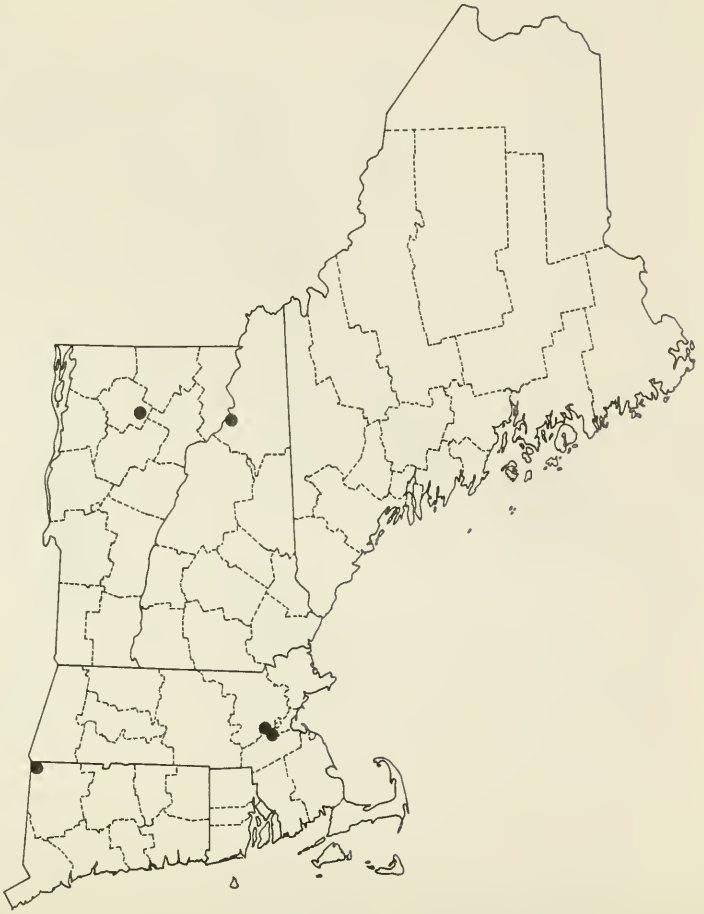
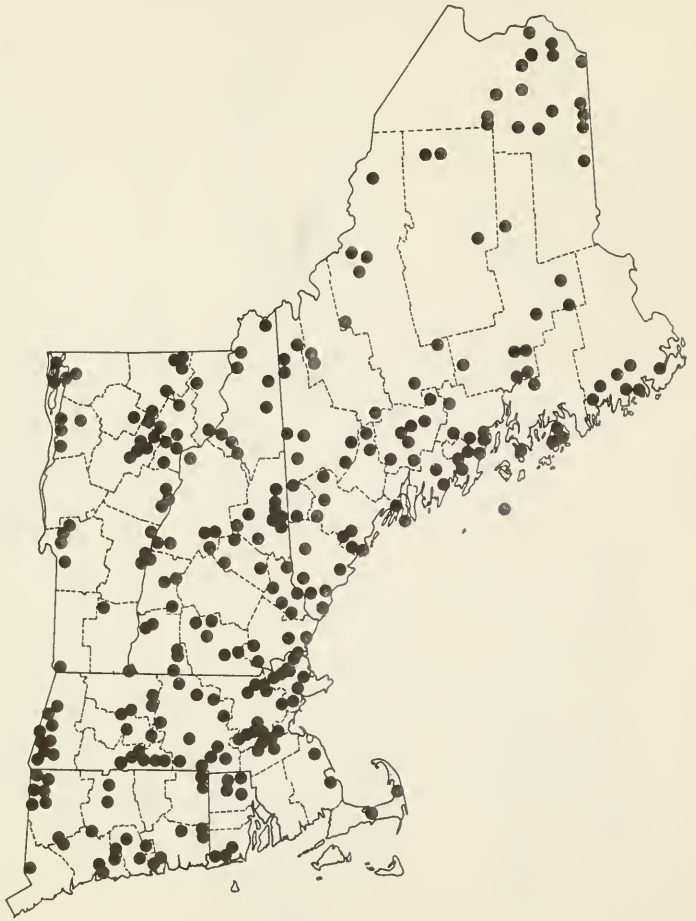


Figure 22.
Potamogeton lateralis: A. habit of fertile plant. B. leaf base. C. leaf. D. fruit. E. portion of sterile plant.



Map 22.
Potamogeton lateralis

Figure 23.
Potamogeton natans: A. upper portion of plant. B. fruit.



Map 23.
Potamogeton natans

22. Potamogeton oakesianus Robbins Fig. 24, Map 24

Common in acid waters of New England. Range extends from Newfoundland west to Wisconsin, south to southern New Jersey, southern Michigan and central Wisconsin.

alkalinity: mean 8.1 mg/l; range 2.0-33.0 mg/l
pH: mean 6.5; range 5.6-8.9

23. Potamogeton crispus L. Fig. 25, Map 25

Common in alkaline waters at scattered locations throughout western and southern New England and in polluted ponds and streams in eastern Massachusetts. Originally introduced from Europe this species has become a troublesome weed in many ponds in western Massachusetts. Range extends from Quebec west to Minnesota, south to Alabama and Texas; scattered throughout the western states.

alkalinity: mean 70.3 mg/l; range 12.0-170.0 mg/l
pH: mean 7.6; range 6.5-9.8

24. Potamogeton amplifolius Tuckerman Fig. 26, Map 26

Common throughout New England, often in deep water. Range extends from Nova Scotia and the Gaspé Peninsula west to British Columbia, south to Virginia, Georgia, Alabama, Arkansas, and Oklahoma; scattered locations in the Pacific northwest and California; most abundant in the Great Lakes region and the northeast United States.

alkalinity: mean 32.6 mg/l; range 3.5-123.5 mg/l
pH: mean 7.3; range 5.7-9.8

25. Potamogeton pulcher Tuckerman Fig. 27, Map 27

Locally abundant in acid waters from western Maine and central New Hampshire south to coastal Connecticut. Range extends west to scattered locations in Michigan and Wisconsin, south to Georgia, Florida, Louisiana, and Texas.

alkalinity: mean 10.3 mg/l; range 3.0-38.0 mg/l
pH: mean 6.6; range 5.6-7.5

26. Potamogeton nodosus Poiret Fig. 28, Map 28

Scattered at locations in eastern New England and locally abundant in western New England. All locations in eastern New England are in fast flowing streams and rivers, mostly of low alkalinity. In contrast, however, it is usually found in slow moving streams or ponds of high alkalinity in western New England. Range extends from New Brunswick west to British Columbia, south to Florida, Alabama, Texas, Arizona, California, and Mexico.

alkalinity: mean 77.8 mg/l; range 5.0-231.5 mg/l
pH: mean 7.8; range 6.8-9.5

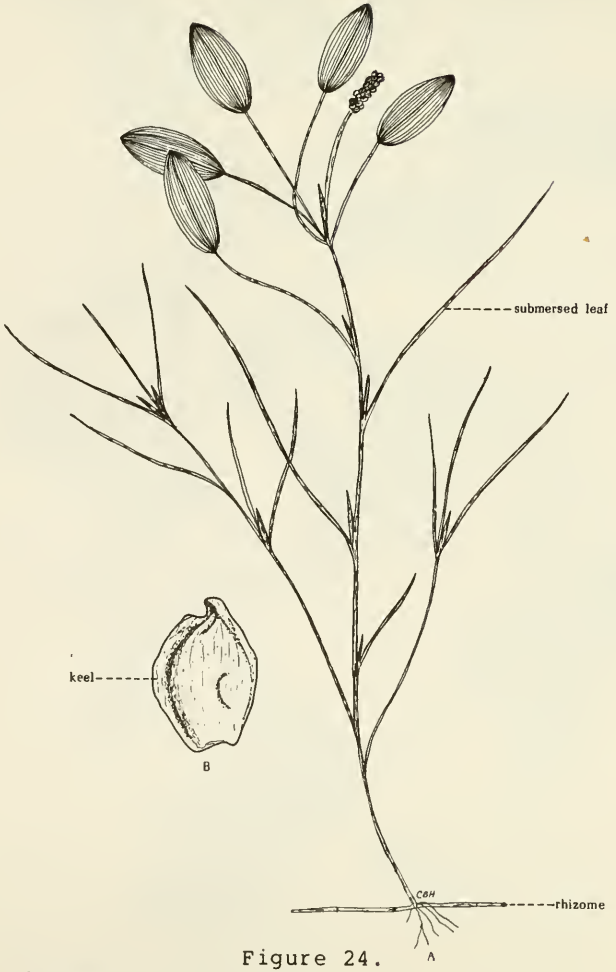
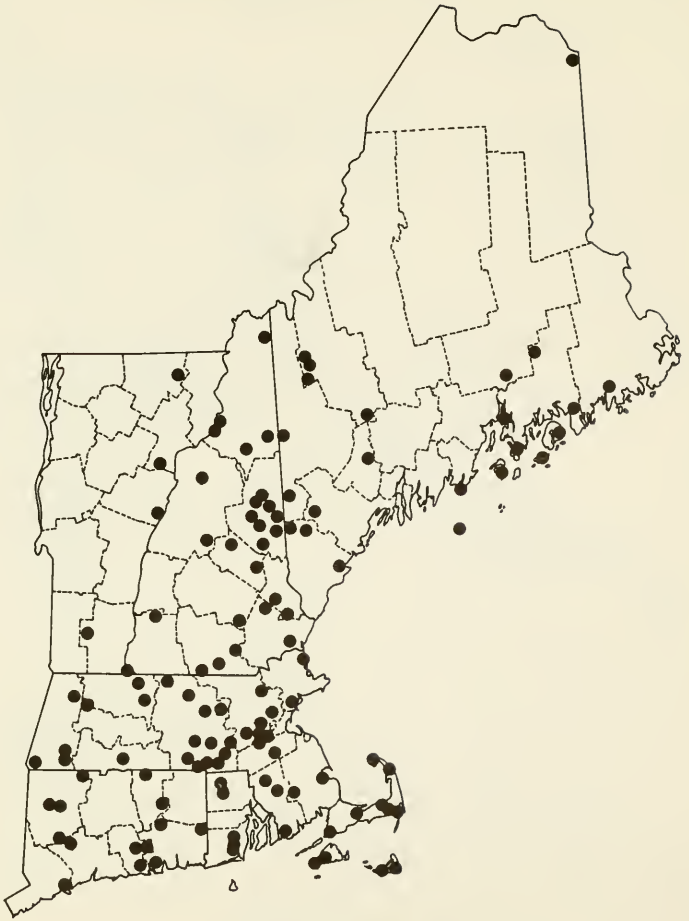


Figure 24.
Potamogeton oakesianus: A. habit. B. fruit.



Map 24.
Potamogeton oakesianus

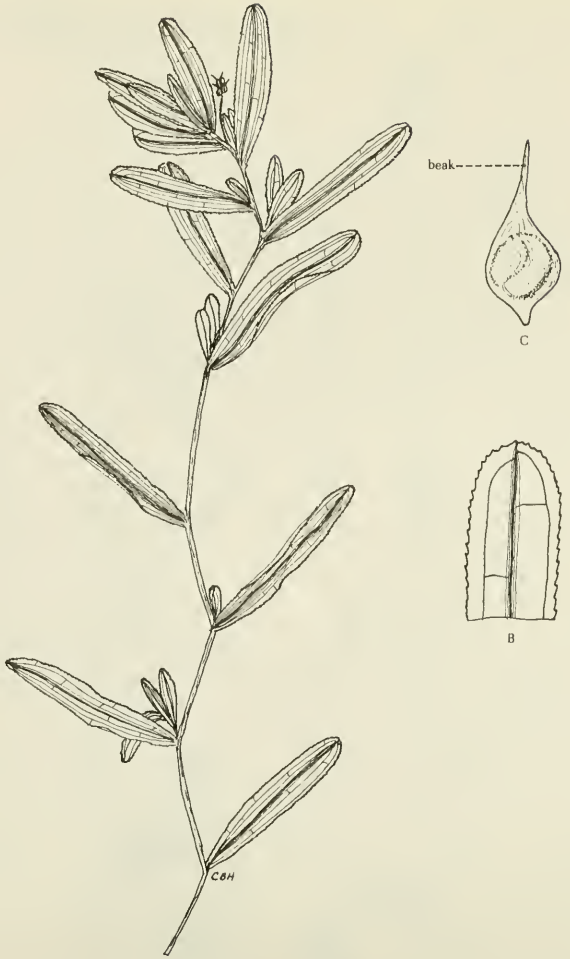
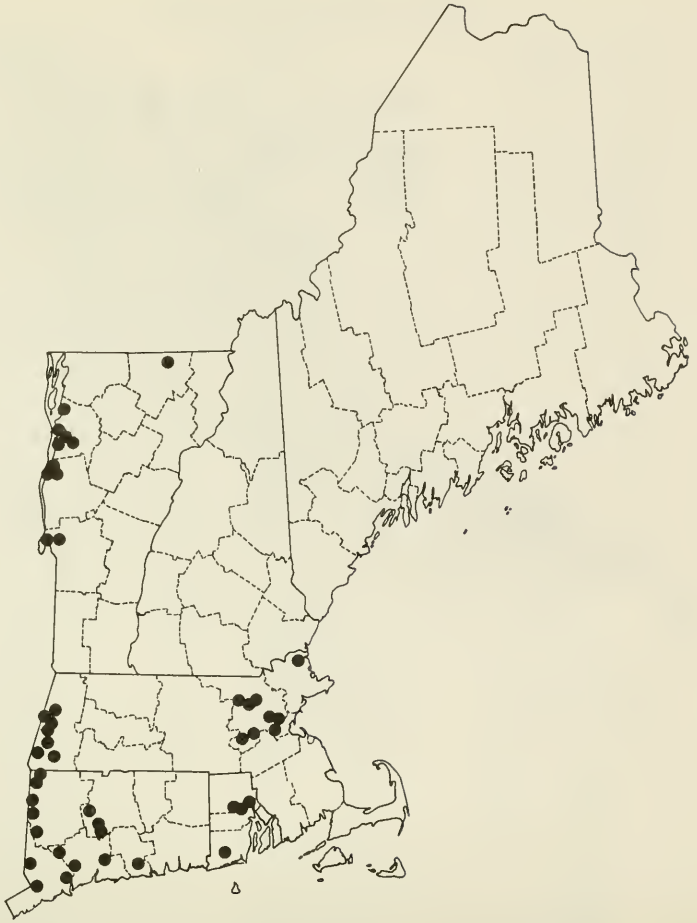
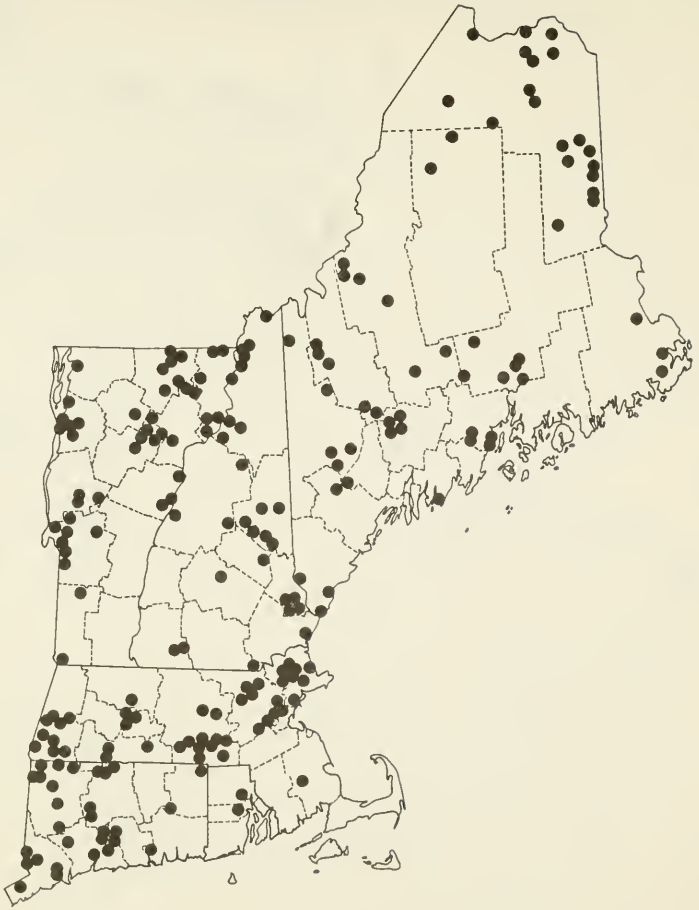


Figure 25.
Potamogeton crispus: A. upper portion of plant. B. leaf tip. C. fruit.



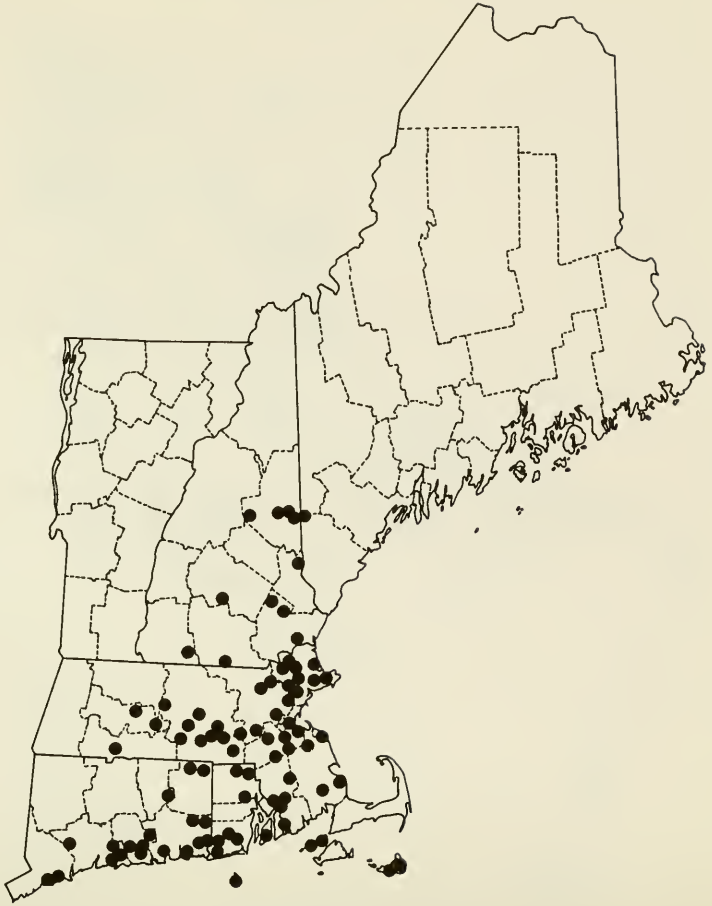
Map 25.
Potamogeton crispus

Figure 26.
Potamogeton amplifolius: A. habit. B. fruit.



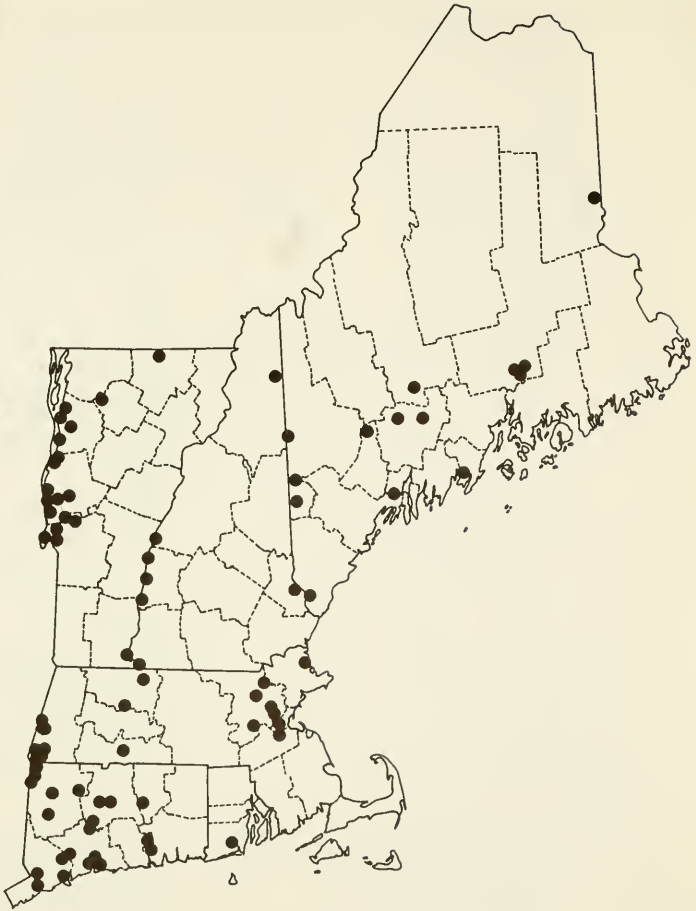
Map 26.
Potamogeton amplifolius

Figure 27.
Potamogeton pulcher: A. habit. B. fruit.



Map 27.
Potamogeton pulcher

Figure 28.
Potamogeton nodosus: A. upper portion of plant. B. fruit.



Map 28.
Potamogeton nodosus

27. Potamogeton alpinus Balbis Fig. 29, Map 29

Common in northern Maine and northern Vermont; sporadic at other locations in northern and western New England. Two varieties have been described, var. subellipticus (Fern.) Ogden and var. tenuifolius (Raf.) Ogden (Ogden, 1943). Plants in New England have been observed with the leaf forms of both varieties on the same plant. Therefore we are not recognizing these varieties as distinct. Range extends from Newfoundland west to Alaska, south to eastern Pennsylvania, New York, Michigan, Minnesota, Colorado, Utah, and California.

Rare and endangered plant list: New Hampshire

alkalinity: mean 40.5 mg/l; range 4.0-115.0 mg/l
pH: mean 7.3; range 6.5-9.9

28. Potamogeton gramineus L. Figs. 30, 31, 32, Maps 30, 31, 32

Extremely common throughout New England. This is a highly variable species that hybridizes with most broad-leaved pondweeds, especially P. illinoensis. Such hybrids are often confused with P. gramineus var. maximus. A rare narrow-leaved form with partially adnate stipules has been described from New Hampshire (Hellquist, 1978). Range extends from Newfoundland west to Alaska, south to New Jersey, Pennsylvania, southern Indiana, Iowa, New Mexico, Arizona and California; most abundant in the Northeast and in the Great Lakes region. Three varieties that blend into each other have been described. Only the extremes are easy to distinguish from the typical variety.

1. Most leaves elliptic to oblanceolate, 0.2-15.0 mm wide, 5-11-veined.
   2. Larger submersed leaves 5-7-veined, up to 8.0 mm wide.
      ..... var. gramineus
   2. Larger submersed leaves 7-9 (-11)-veined, up to 15 mm wide.
      ..... var. maximus Morong
1. Most leaves with sides often parallel, 1-3 mm wide, 3-veined.
   ..... var. myriophyllus Robbins

alkalinity: mean 29.9 mg/l; range 2.5-123.5 mg/l
pH: mean 7.1; range 5.0-9.8

29. Potamogeton illinoensis Morong Fig. 33, Map 33

Locally abundant in hard waters of western New England. Presently it is found at only two eastern Massachusetts sites. This species often hybridizes with P. gramineus. Such hybrids are confused with P. gramineus var. maximus. Range extends from New England west to southern Manitoba and British Columbia, south to Florida, Texas, southern California, and Mexico; most abundant in the Great Lakes region, eastern New York, and western New England.

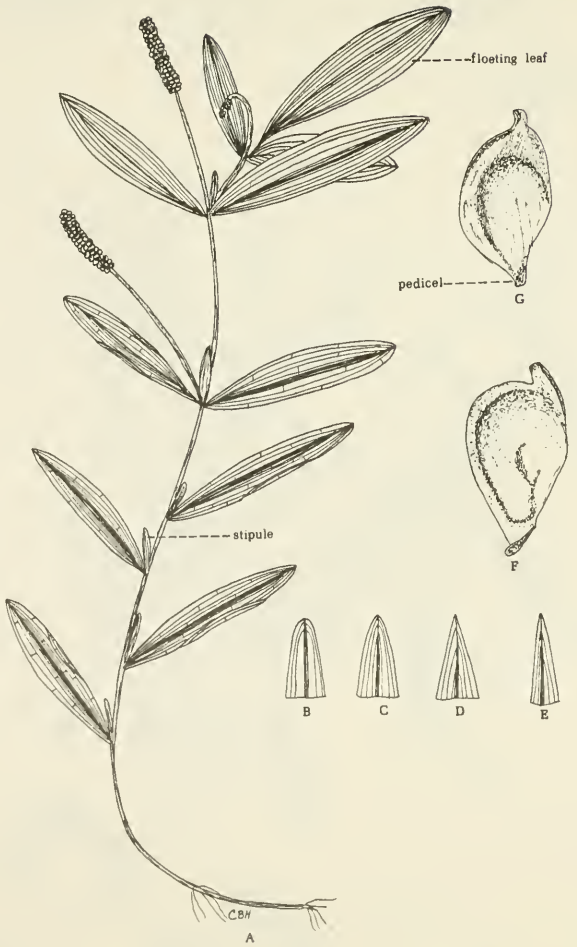
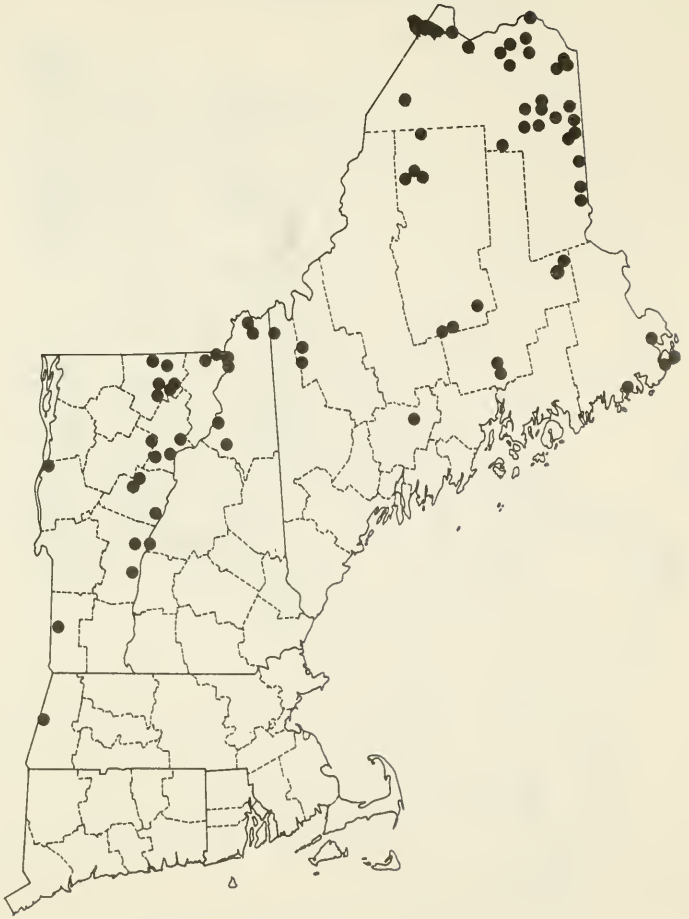
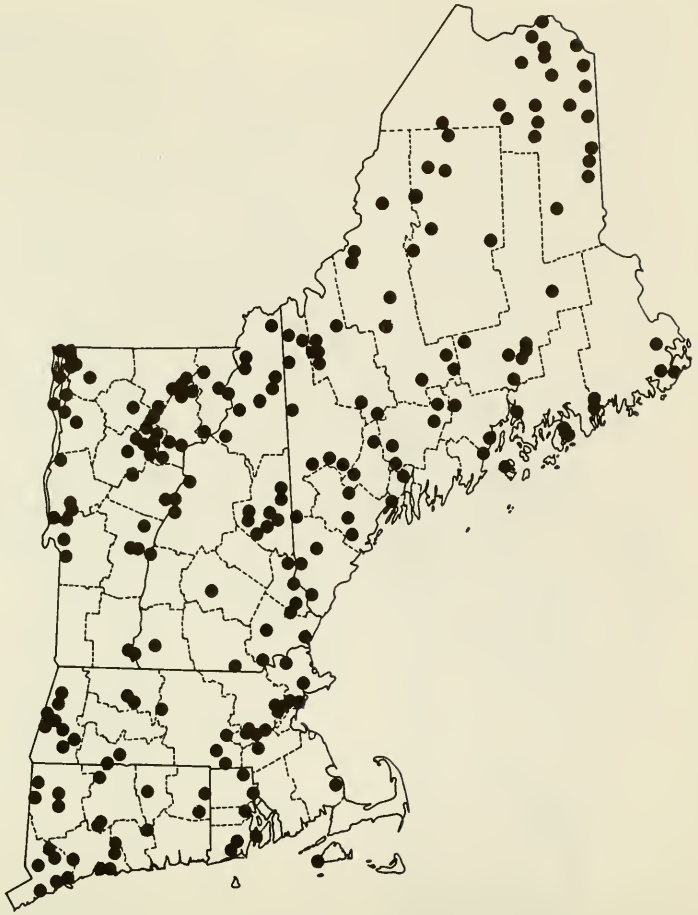


Figure 29.
Potamogeton alpinus: A. habit. B-E. leaf tips F-G. fruits.



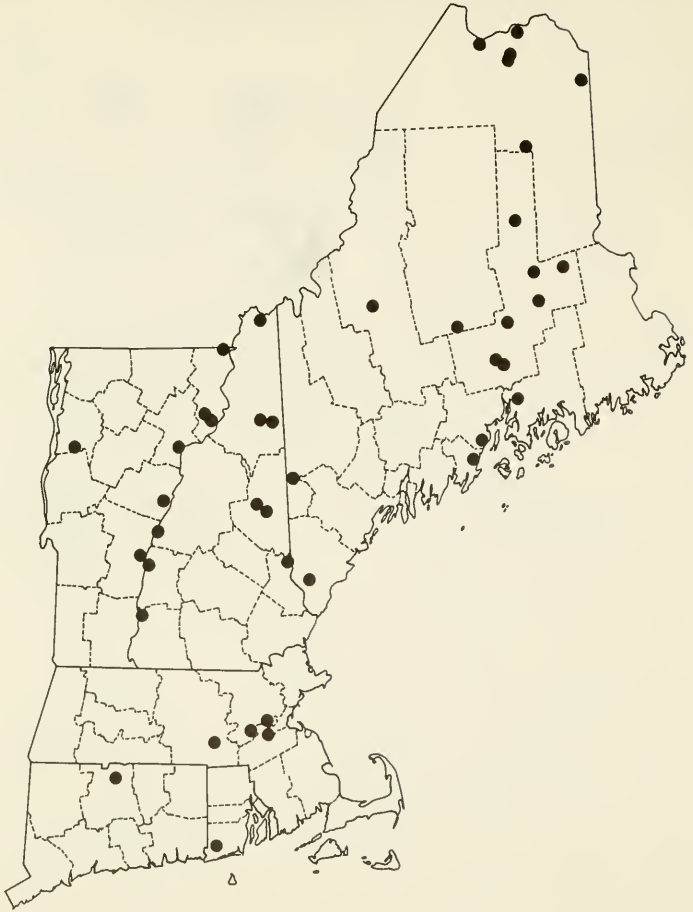
Map 29.
Potamogeton alpinus

Figure 30.
Potamogeton gramineus var. gramineus:
A. habit. B. fruit.



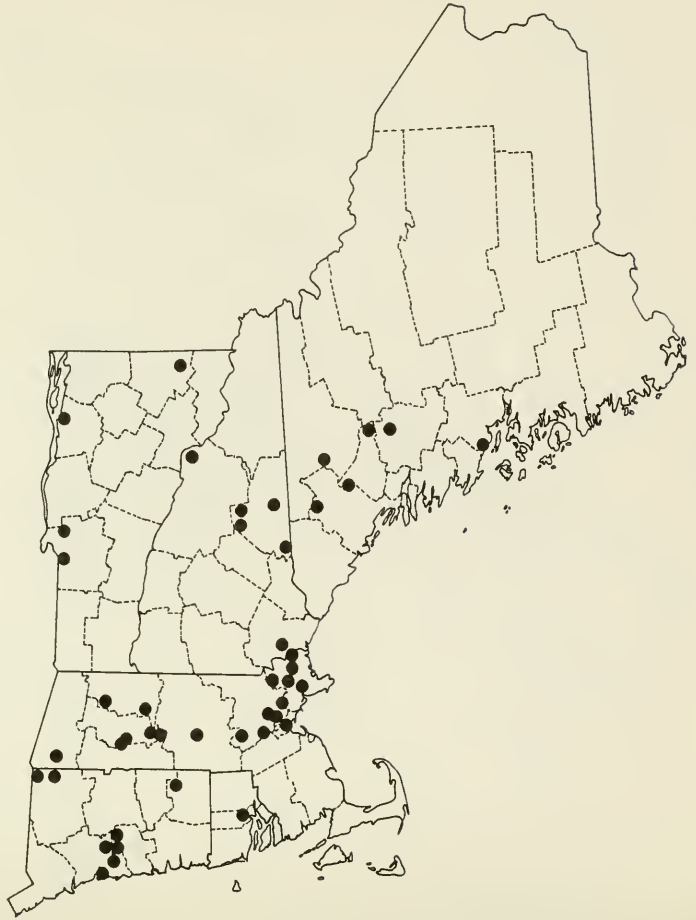
Map 30.
Potamogeton gramineus
var. gramineus

Figure 31.
Potamogeton gramineus var. maximus:
upper portion of plant.



Map 31.
Potamogeton gramineus
var. maximus

Figure 32.
Potamogeton gramineus var. myriophyllus:
upper portion of plant.



Map 32.
Potamogeton gramineus
var. myriophyllus

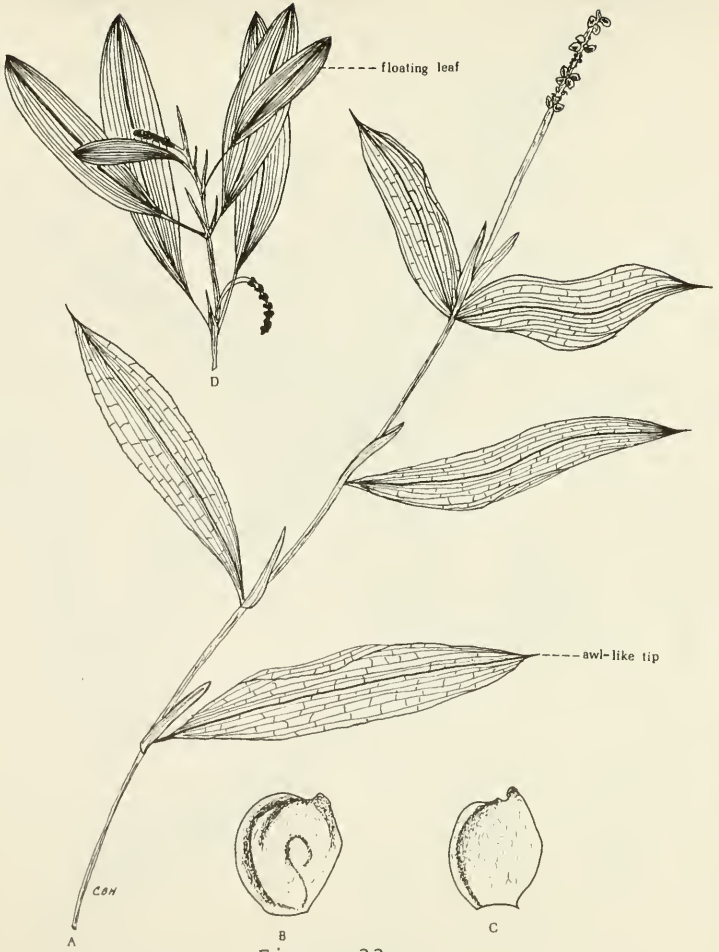
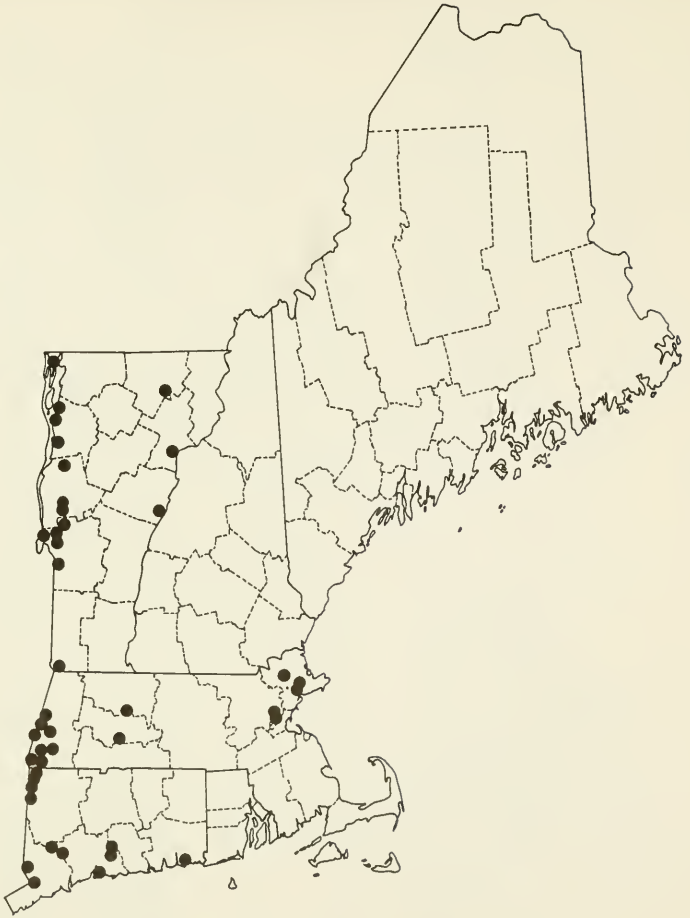


Figure 33.
Potamogeton illinoensis: A. upper portion of plant. B-C. fruits. D. upper portion of plant.



Map 33.
Potamogeton illinoensis

alkalinity: mean 68.6 mg/l; range 20.0-123.5 mg/l
pH: mean 8.3; range 6.8-10.6

30. Potamogeton praelongus Wulfen Fig. 34, Map 34

Locally abundant, usually in deep waters of moderate alkalinity in New England. Range extends from Labrador west to Alaska, south to New Jersey, Ohio, Indiana, Colorado, Utah, and California.

Rare and endangered plant list: New Hampshire

alkalinity: mean 47.2 mg/l; range 8.0-123.5 mg/l
pH: mean 7.7; range 6.7-9.8

31. Potamogeton richardsonii (Benn.) Rydb. Fig. 35, Map 35

Locally abundant in northern Maine and western New England; sporadic elsewhere. Often confused with P. perfoliatus with which it may hybridize. Range extends from eastern Quebec west to Alaska, south to New England, New York, Pennsylvania, Indiana, Iowa, Colorado, Utah, and California.

Rare and endangered plant list: New Hampshire, however, specimens from New Hampshire have since been reidentified as P. perfoliatus and the taxon does not occur in that state.

alkalinity: mean 46.0 mg/l; range 13.5-111.5 mg/l
pH: mean 7.6; range 6.7-10.2

32. Potamogeton perfoliatus L. Fig. 36, Map 36

Common in New England in acid, alkaline and saline coastal waters. In New England, leaves become more lanceolate in acid waters and more orbicular in saline waters. Populations in the United States have been referred to var. bupleuroides (Fern.) Farwell. Haynes (pers. comm.) has observed morphological variation in the taxon from north to south, but since the variation is clinal, lacking discontinuity, no additional taxa have been recognized. Range extends from Newfoundland to Ontario, south to North Carolina, Alabama, and Louisiana; most abundant along the coast.

alkalinity: mean 47.2 mg/l; range 8.0-123.5 mg/l
pH: 7.7; range 6.7-9.8
chloride: mean 135.1 mg/l; range 1.6-4095.0 mg/l

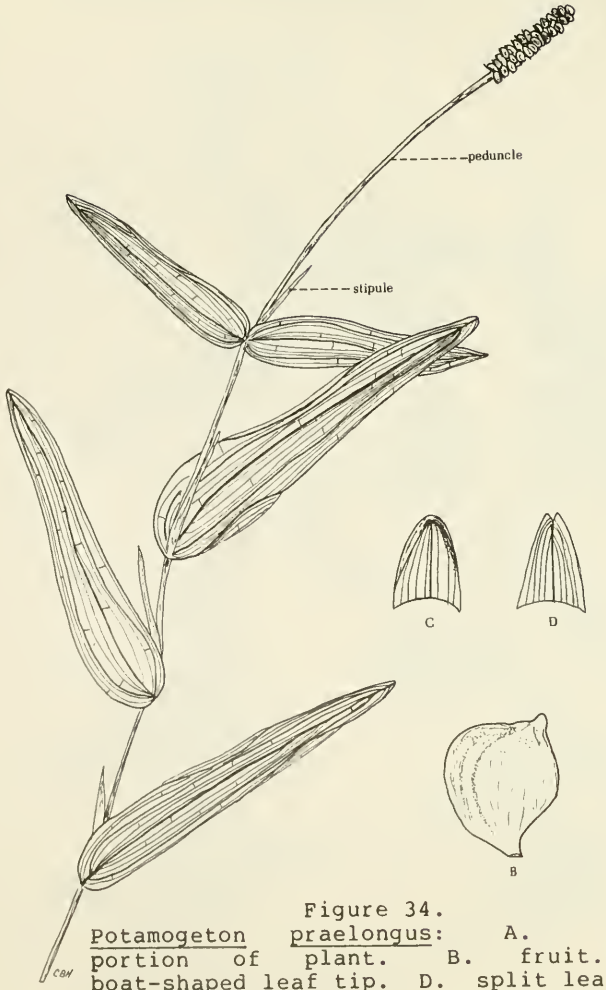
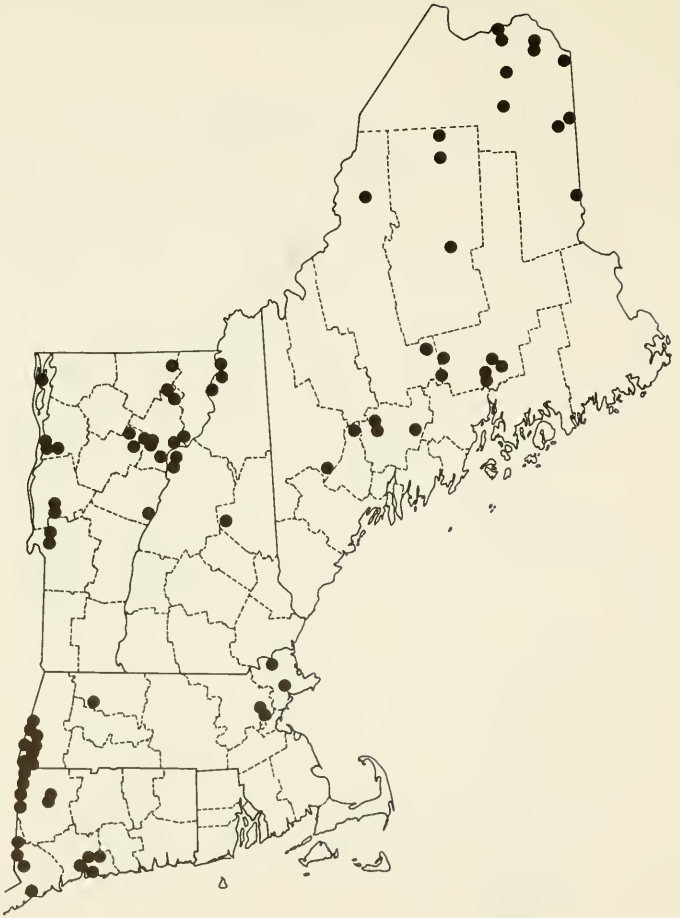
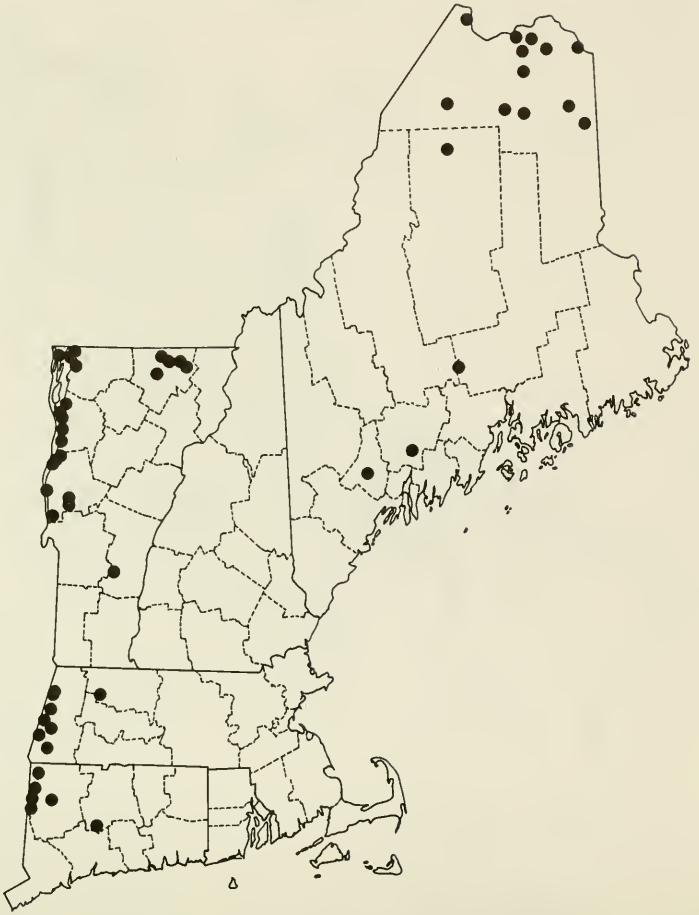


Figure 34.
Potamogeton praelongus: A. upper portion of plant. B. fruit. C. boat-shaped leaf tip. D. split leaf tip after pressing.



Map 34.
Potamogeton praelongus

Figure 35.
Potamogeton richardsonii: A. habit. B. fruit. C. leaf.



Map 35.
Potamogeton richardsonii

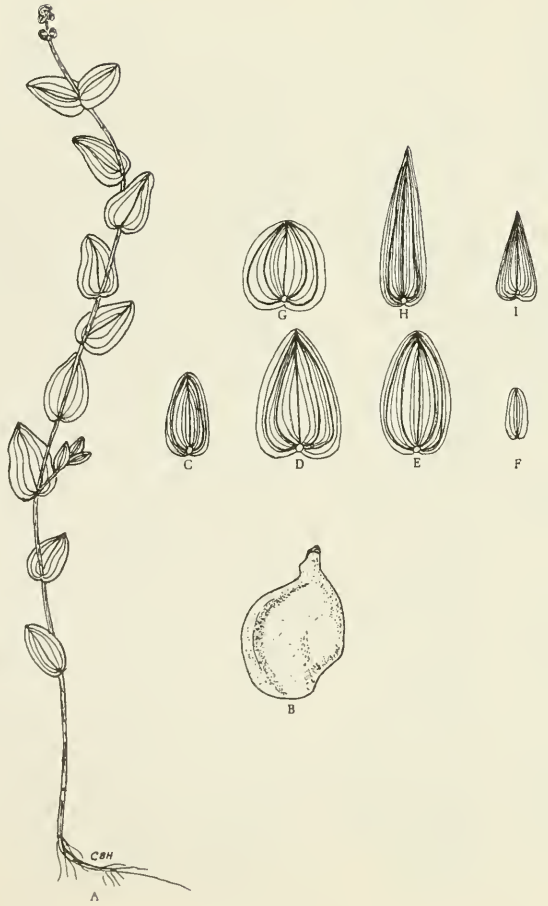
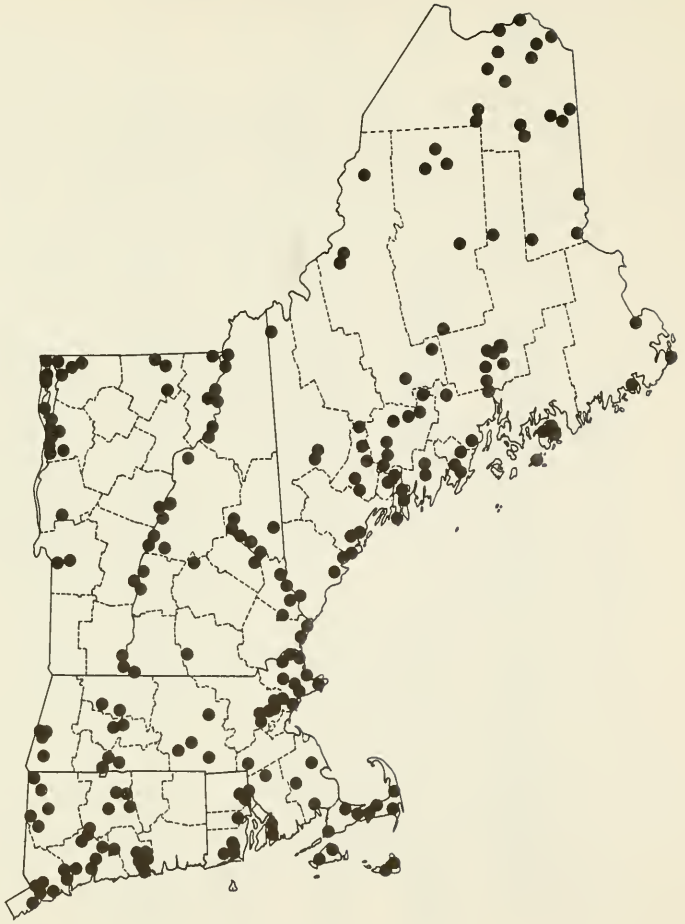


Figure 36.
Potamogeton perfoliatus: A. habit. B. fruit. C-I. leaves.



Map 36.
Potamogeton perfoliatus

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Ruppia (Widgeon-grass)

Submersed plants of saline water arising from rhizomes; leaves alternate, blades fused with the stipule; floating leaves absent; flowers 2, enclosed in leaf sheath at anthesis, fruits long-stalked, 4 per flower, usually below the water surface.

1. Ruppia maritima L. Fig. 37, Map 37

Common in brackish and saline water along the coast. Richardson (pers. comm.) has observed that peduncles of underwater pollinated flowers remain straight, while peduncles of surface pollinated flowers become recoiled following fertilization. This treatment includes the seven varieties recognized by Fernald (1950). Richardson (in press) notes that R. maritima is a plant of broad ecological amplitude and that clinal variations in vegetative morphology and reproductive behavior observed in New Hampshire salt marshes are apparently expressions of adaptation to a diversity of habitats. It appears to us that a re-evaluation of the varieties is necessary. Range extends along the coast from Newfoundland to Florida and along the Pacific Coast from Washington to California and Mexico; at scattered locations inland.

alkalinity: mean 42.7 mg/l; range 7.0-169.0 mg/l
pH: mean 7.9; range 6.4-10.7
chloride: mean 1729.3 mg/l; range 191.1-4095.0 mg/l

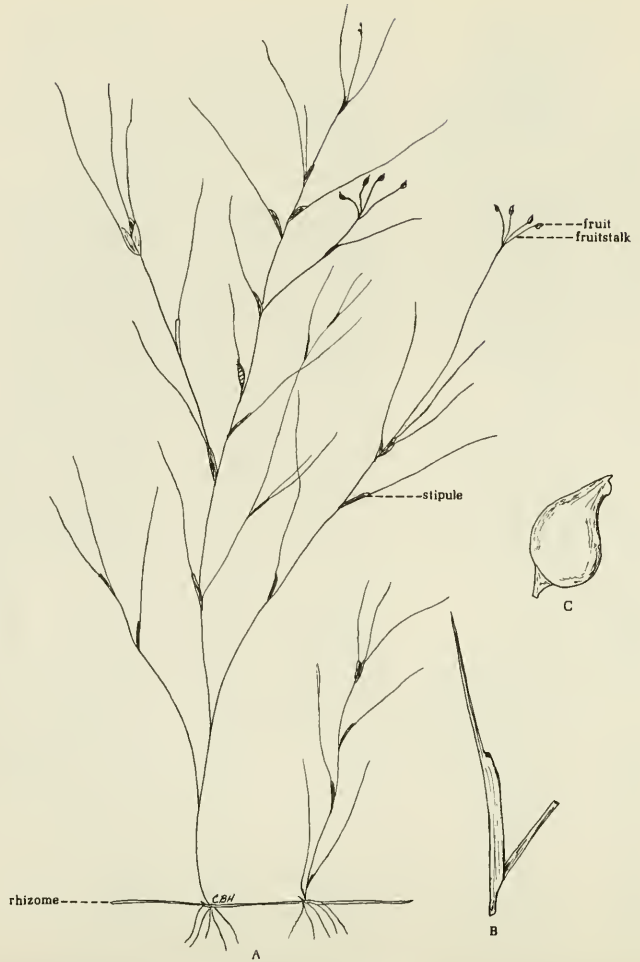
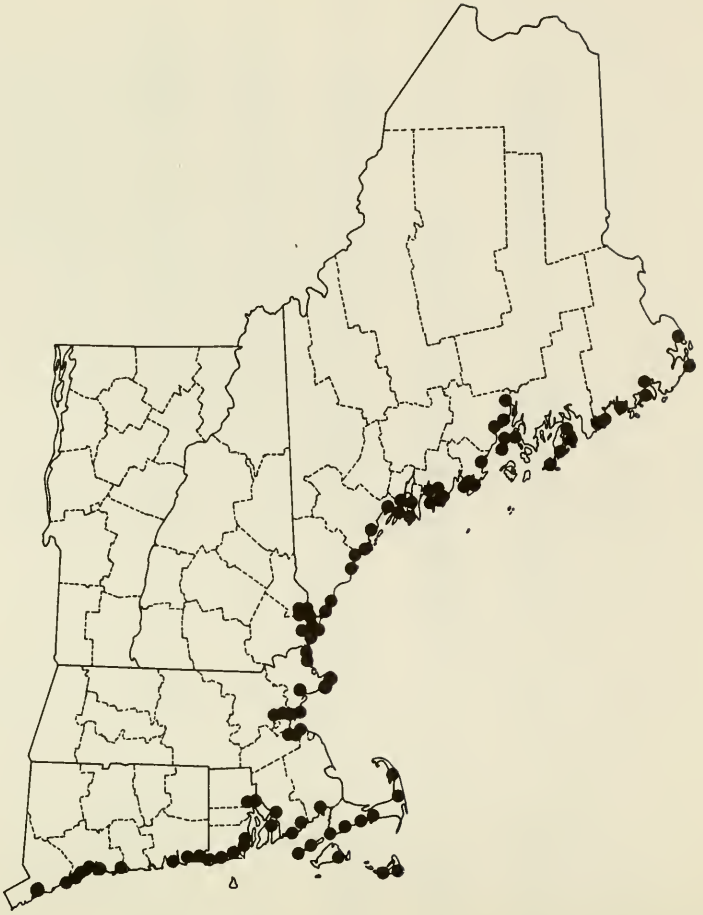


Figure 37.
Ruppia maritima: A. habit. B. leaf base and stipule. C. fruit.



Map 37.
Ruppia maritima

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ZANNICHELLIACEAE

Zannichellia (Horned Pondweed)

Submersed plants of saline waters along the coast or highly alkaline waters inland; arising from rhizomes; leaves linear, opposite to subopposite; fruits axillary on short stalks, usually below the surface.

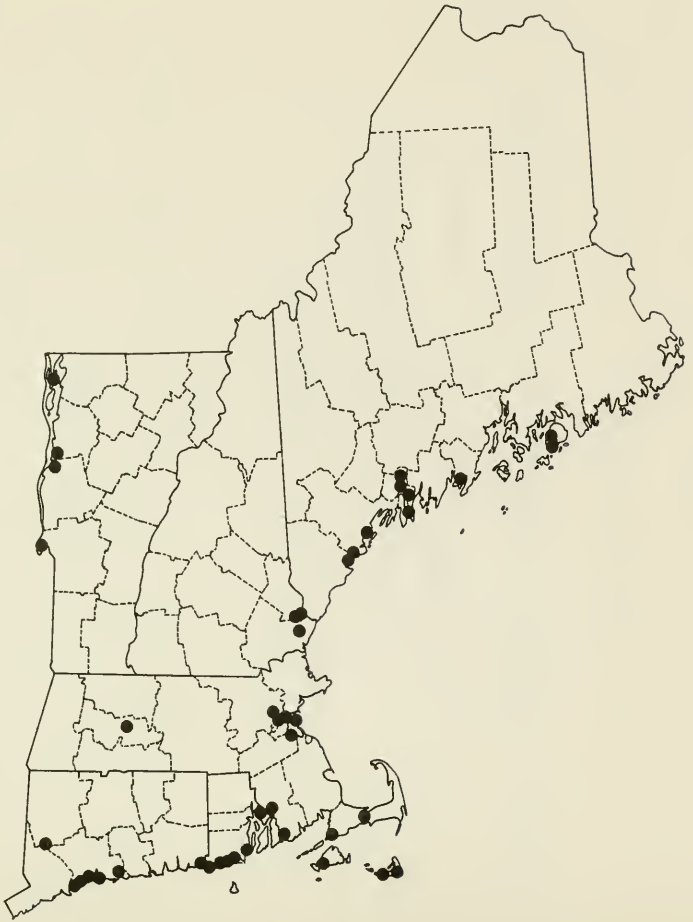
1. Zannichellia palustris L. Fig. 38, Map 38

Uncommon in saline waters along the coast with scattered locations in alkaline waters, mainly in the Lake Champlain Valley of Vermont. Includes the broader-leaved variety major (Boenn.) W. D. J. Koch. Range extends from eastern Quebec west to Alaska, south throughout the United States to Mexico in saline or alkaline waters.

Rare and endangered plant lists: Maine, Vermont, Connecticut

alkalinity: mean 13.5 mg/l; range 7.5-19.5 mg/l
pH: mean 6.9; range 6.5-7.2
chloride: mean 693.6 mg/l; range 185.0-1201.6 mg/l

Figure 38.
Zannichellia palustris: A. habit. B. fruit. C-D. leaf tips.



Map 38.
Zannichellia palustris

NAJADACEAE

Najas (Naiad)

Submersed annuals of fresh and sometimes saline water; leaves sub-opposite or appearing whorled; serrate or spinulose along the edges; fruit borne in the axils of the leaves; submerged.

Key to Species

1. Leaf bases tapered (figs. 39B,C, 40D).

    2. Leaves acute or rounded, not sharp-pointed (figs. 39B,C); style 0.5 mm or less in length (fig. 39D); seed dull, with 15-18 rows of areolae (fig. 39E). ..... N. guadalupensis

    2. Leaves tapered to a sharp point (fig. 40D); style 1.0 mm or more in length (fig. 40B); seed shiny, with 30-40 rows of areolae (fig. 40C). ..... N. flexilis

1. Leaf bases lobed (Figs. 41B, 42B,C).

    3. Leaf blades, usually less than 0.3 mm wide (fig. 41B); leaf margins not conspicuously toothed to the unaided eye (fig. 41B); fruit with approximately 24 rows of areolae (fig. 41D). ..... N. gracillima

    3. Leaf blades 0.3-0.5 mm wide (figs. 42B,C); leaf margins often conspicuously toothed to the unaided eye (figs. 42B,C); fruit with 12-18 rows of areolae (fig. 42D) ..... N. minor

1. Najas guadalupensis (Spreng.) Magnus Fig. 39, Map 39

Rare but locally abundant in alkaline, acid or brackish waters at eleven widely scattered localities in New England. Range extends from southwestern Quebec and Maine west to Michigan, South Dakota, Idaho, and Oregon, south throughout the United States and Mexico.

Rare and endangered plant lists: Massachusetts, Vermont

alkalinity: mean 25.7 mg/l; range 19.5-41.5 mg/l
pH: mean 7.4; range 7.2-7.5
chloride: mean 413.5 mg/l; range 10.9-1201.2 mg/l

2. Najas flexilis (Willd.) Rostk. and Schmidt Fig. 40, Map 40

Extremely common throughout New England. Range extends from Newfoundland west to Minnesota, Alberta and British

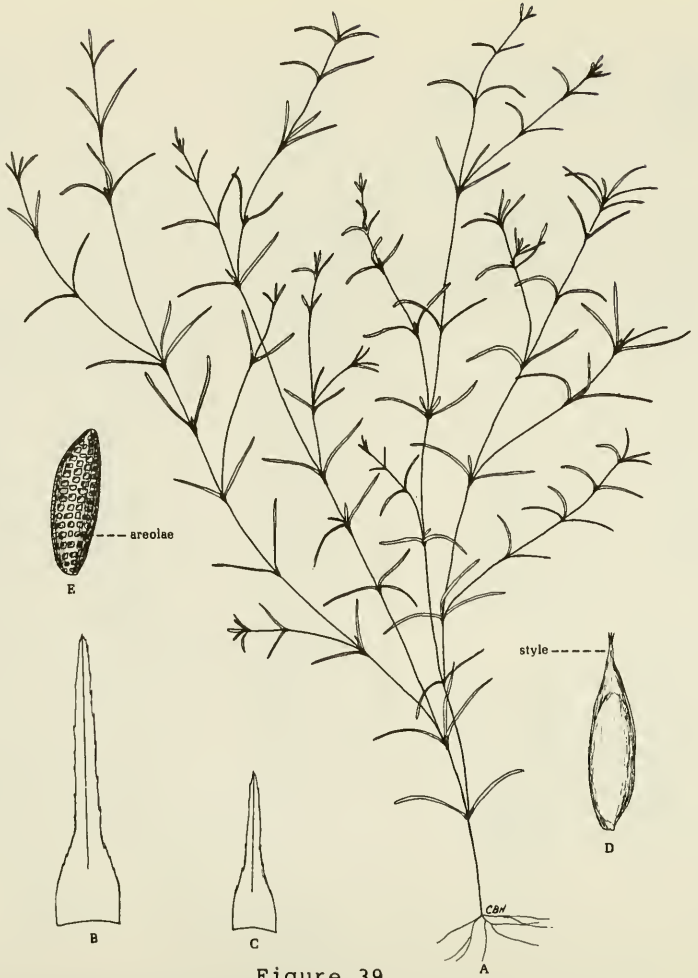
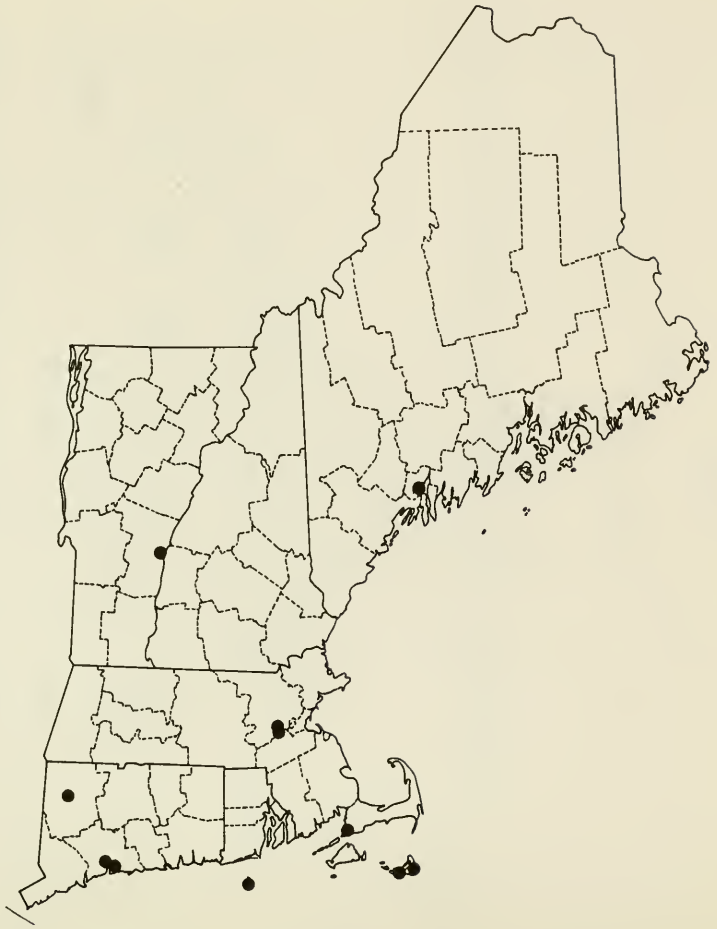


Figure 39.
Najas guadalupensis: A. habit. B-C. leaves. D. fruit. E. seed.



Map 39.
Najas guadalupensis

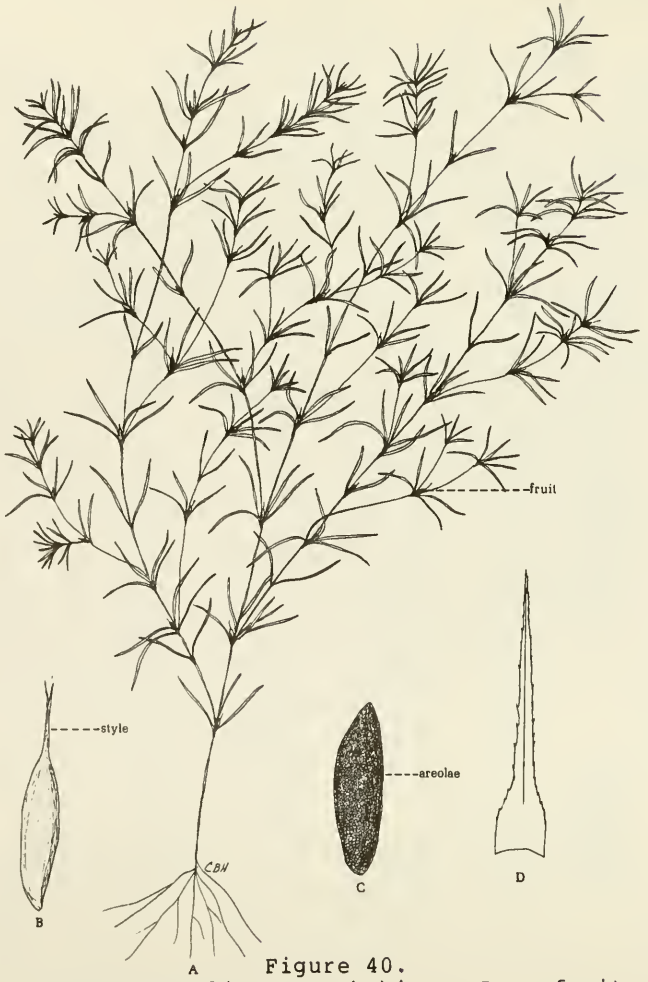
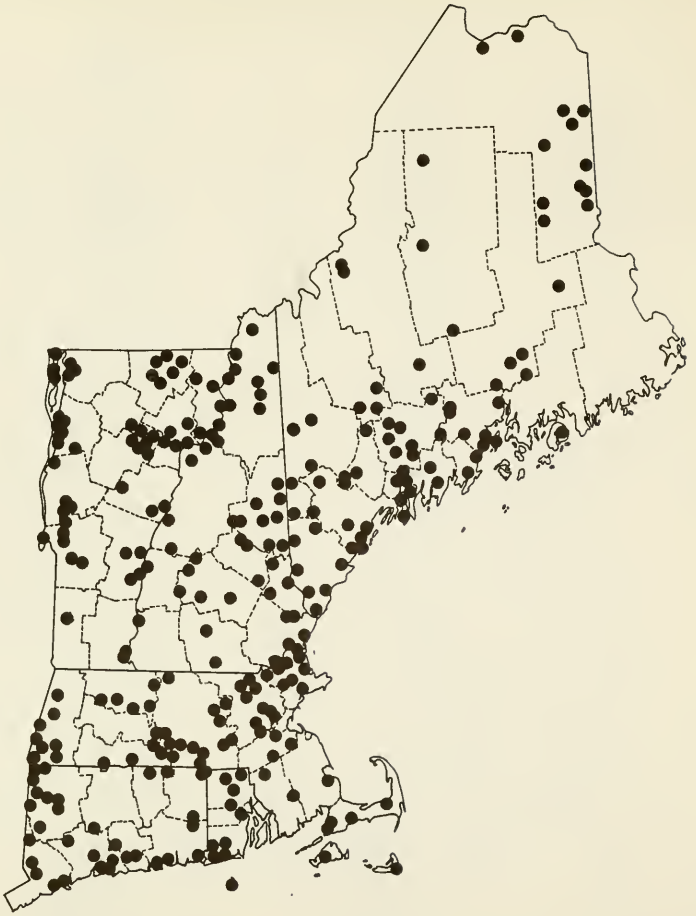


Figure 40.
Najas flexilis: A. habit. B. fruit. C. seed. D. leaf.



Map 40.
Najas flexilis

Columbia, south to Virginia, Ohio, Indiana, Iowa, and Oregon.

alkalinity: mean 36.5 mg/l; range 4.0-245.0 mg/l
pH: mean 7.4; range 6.4-10.2

3. Najas gracillima (A. Br.) Magnus Fig. 41, Map 41

Locally abundant in acid waters, mainly of southern New England. Range extends from Maine west to Minnesota, south to Virginia, Kentucky, Alabama, and Missouri; one isolated station in California.

Rare and endangered plant list: Vermont

alkalinity: mean 4.6 mg/l; range 2.5-9.0 mg/l
pH: mean 6.2; range 5.7-6.7

4. Najas minor All. Fig. 42, Map 42

Rare in alkaline waters of extreme western New England. This European introduction has not made much movement eastward into New England from New York where it is more abundant. Range extends from western New England west to Michigan and Indiana, south to Florida, Mississippi, and Arkansas.

alkalinity: mean 101.0 mg/l; range 99.5-102.5 mg/l
pH: mean 7.8; range 7.3-8.2

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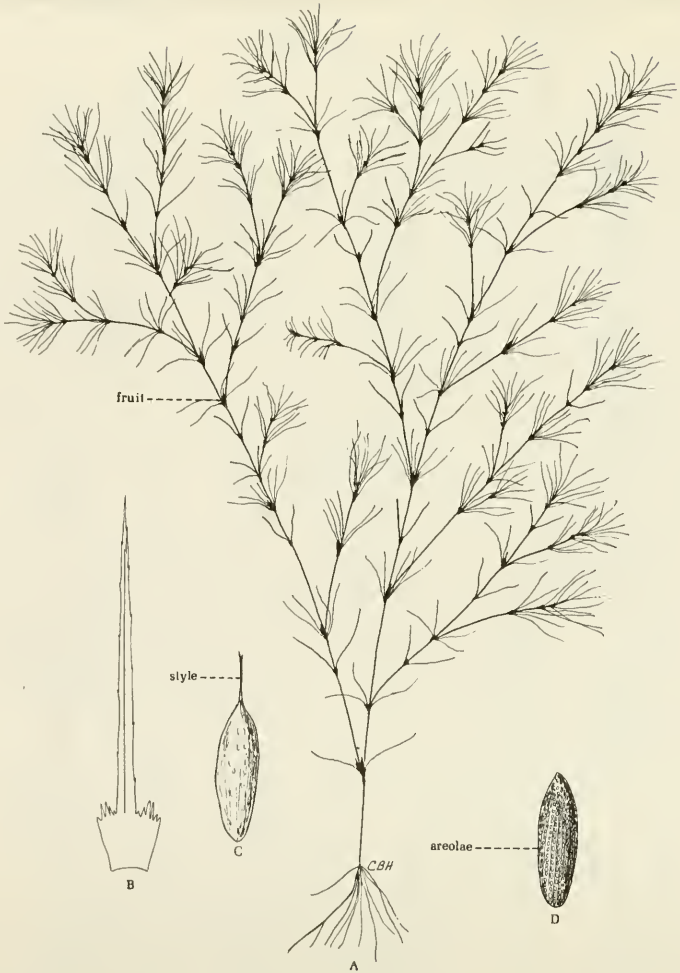
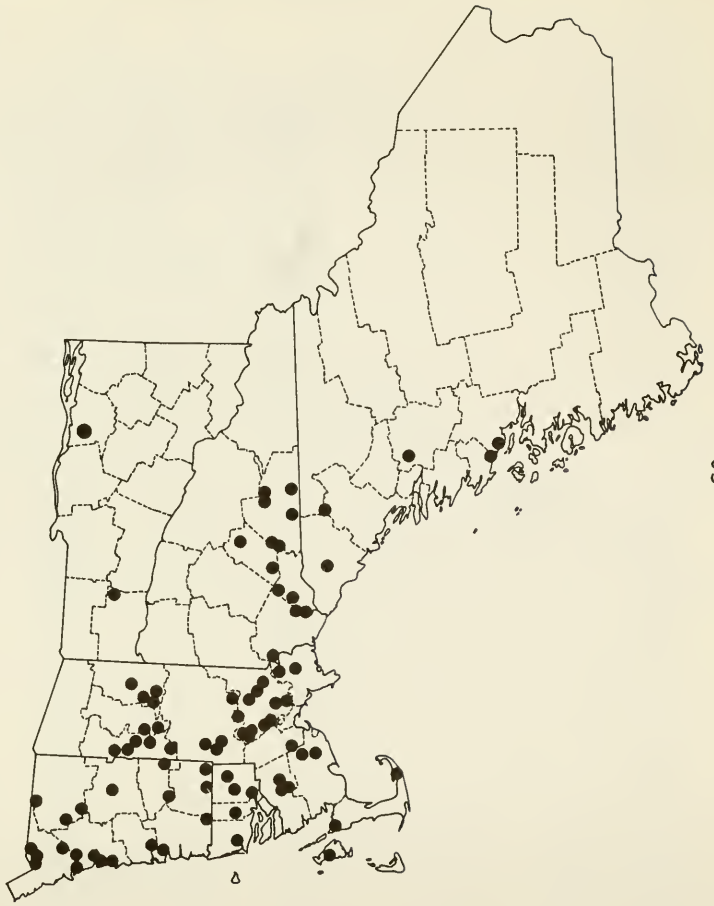


Figure 41.
Najas gracillima: A. habit. B.leaf. C. fruit. D. seed.



Map 41.
Najas gracillima

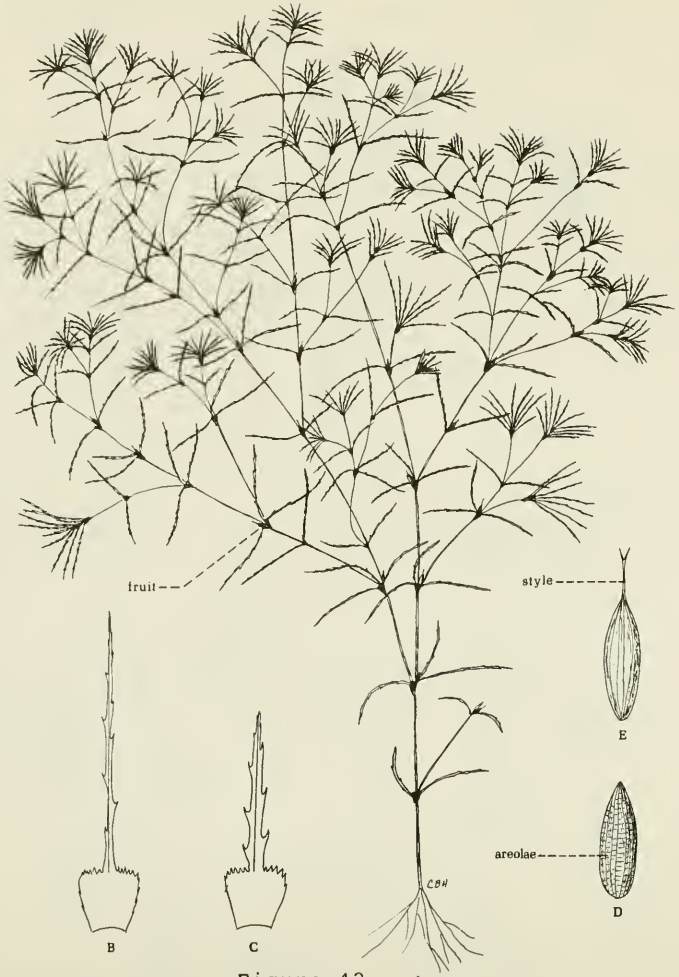
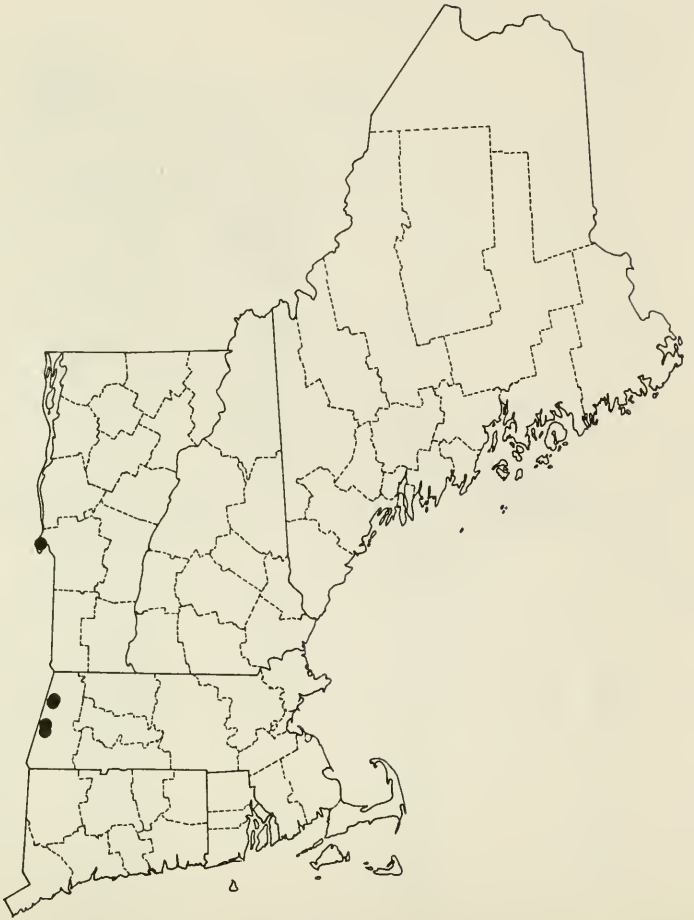


Figure 42.
Najas minor: A. habit. B-C. leaves. D. seed. E. fruit.



Map 42.
Najas minor

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